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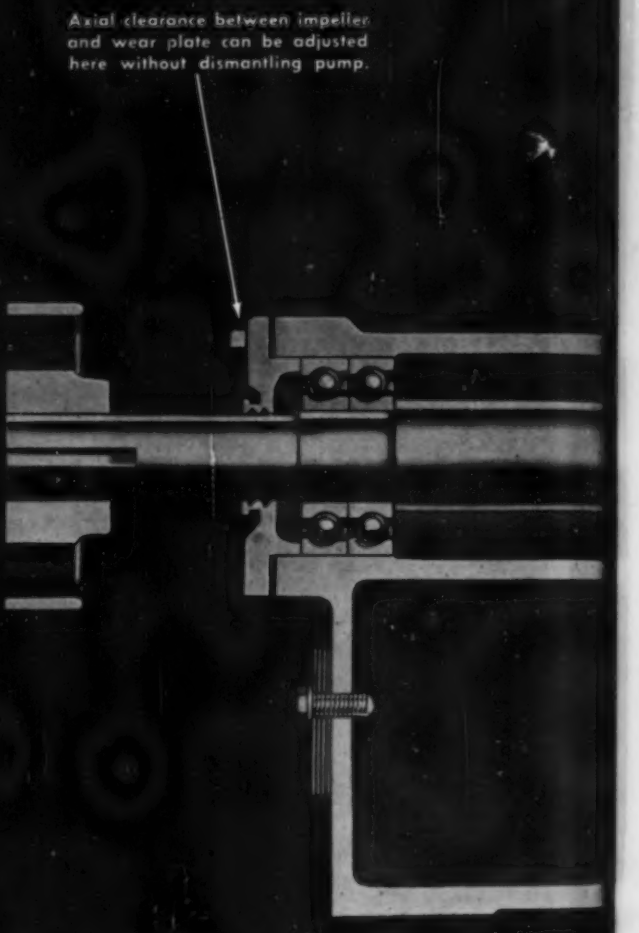
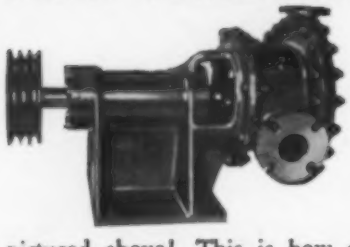
This Pump Saved $1000



PAID FOR ITSELF TWICE OVER IN LESS THAN 2 YEARS PUMPING CORROSIVE, ABRASIVE LIQUIDS . . . MAINTAINED HEAD AND CAPACITY . . . REQUIRED ONLY NEW PACKING!

Allis-Chalmers Process Pump may result in Savings



$1,000 SAVINGS in maintenance alone the first year it was installed *more than* paid the original cost of the Allis-Chalmers *process pump* pictured above! This is how one large food processing company, faced with the problem of pumping acidulous liquids containing suspended carbon, reduced their operating costs. The previous pump had required frequent and costly parts replacements.

Both corrosive and abrasive liquids can be handled with this unique pump. Stuffing box is located on suction side of pump . . . pressures are limited to suction conditions . . . most leakage is eliminated. Casing, impeller and wear plate are all separate pieces which can be easily and inexpensively replaced. Only worn part need be changed.

Adjustable clearance between impeller and wear plate makes it possible to adjust rotating element axially to maintain original pumping capacity and head. This can be done quickly, by merely placing proper shim between pedestal and bearing cover. Casing can be removed without disturbing suction piping or bearing alignment. Entire pump is built sturdily—with large shaft . . . heavy bearings.

It will pay you to consult the A-C representative in your locality about the application of this new *process pump* to your job. Capacities to 1,300 gpm; heads to 275 ft. Write for **Bulletin 08B6615. ALLIS-CHALMERS, MILWAUKEE 1, WIS.**

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COMMENTS ON THE NEWS OF CHEMICAL ENGINEERING IN INDUSTRY

Volume 55 | JUNE • 1948 | Number 6

Japanese reparations program has been all but scuttled by the report of the Johnston Committee just issued by the Army's Secretary Kenneth C. Royall. The Johnston Committee has called for an over-all slash of 73 percent in the value of Jap reparations (industrial plus war facilities). This goes even further than the recommendations of the Overseas Consultants (the Strike group). And it knocks into a cocked hat State's hopes for the SWNCC reparations program, whereby all of Japan's war facilities were earmarked for destruction (with usable equipment to be removed as reparations) and industrial capacity was either cut back or eliminated by reparations shipments to other nations. The pressure to build up Japan's industry and thus lighten the burden on the U.S. taxpayer is too great to resist. (It takes about $500 million a year to keep Japan limping along). Besides, there are those in Washington who think that a strong Japan is a good bet to forestall any strong-arm stuff that Russia might be planning in the Far East.

Like Overseas Consultants, the Johnston group does not think that any iron and steel, machine tool, sulphuric acid, ball and roller bearing, caustic soda and electric power capacity should be removed from Japan. The two groups agree that removals of industrial capital equipment from Japan should be confined to the nitric acid, synthetic rubber, ship building and light metals industries. But the Johnston report differs from the report of Overseas Consultants in two main points. The Johnston group thinks that less nitric acid, synthetic rubber and ship building capacity should be removed. (Both reports see eye-to-eye on light metals.) And, whereas the Overseas Consultants did not tamper with an estimated 1,476 million yen (1939 value) of primary war facilities ticketed for reparations, the Johnston group cut that down by more than 60 percent to only 560 million yen.

Alcohol from wood waste can be made in the plant at Springfield, Ore., that War Assets Administration has on the block again after a year's delay. WAA has advertised a cutoff date for bids on the $3 million plant. The date will fall in July.

There are three hitches to quick disposal of the plant to private industry: (1) the plant was not successful the first time, so it is still a speculative risk; (2) it will cost at least $300,000 to modify its design; and (3) its profitable operation hinges on the price of industrial alcohol, which may drop.

Formerly operated by the Willamette Valley Wood Chemical Co., the Springfield plant, first of its kind on this continent, produces industrial alcohol from sawmill waste by the continuous percolation process. With its five percolators, it has an annual capacity of more than 4 million gallons. Hydrolysis with weak sulphuric acid is employed. Cellulose is converted into sugar and sugar into ethyl alcohol. The plant also may be equipped to produce wood sugar molasses and yeast. Lignin and other by-products (calcium sulphate, carbon dioxide, furfural, methanol, fusel oil and residue sugars) are all-important in the showdown economics of its operation.

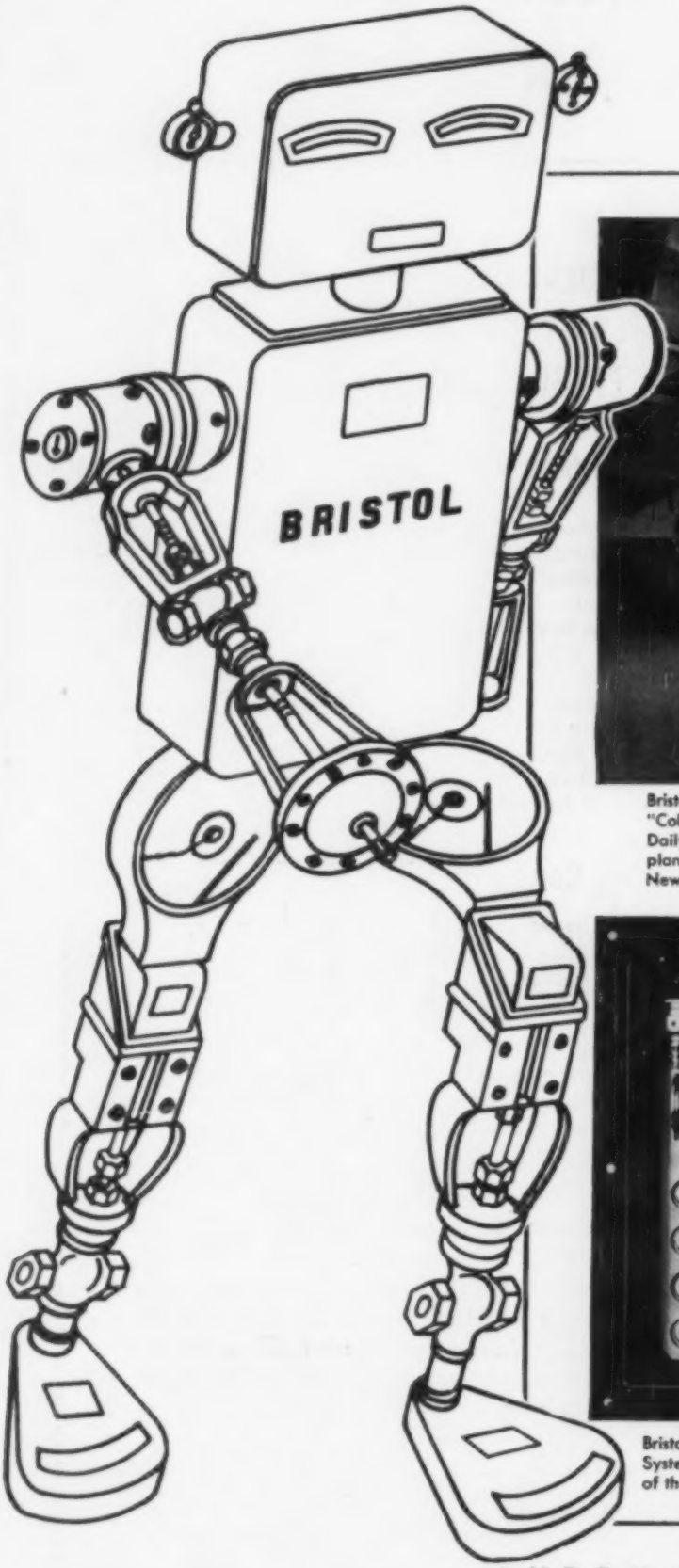
A few experienced chemical operators have nibbled at the WAA offer. But the final deal, if there is one, probably will be negotiated. For the government wants the plant kept on alcohol production. The purchaser cannot cannibalize it.

Even if there are no takers, WAA still has an ace up its sleeve. It may turn the Springfield unit over to the Department of Agriculture's Forest Service, which sponsored its construction during the war. The Forest Service would operate the plant with

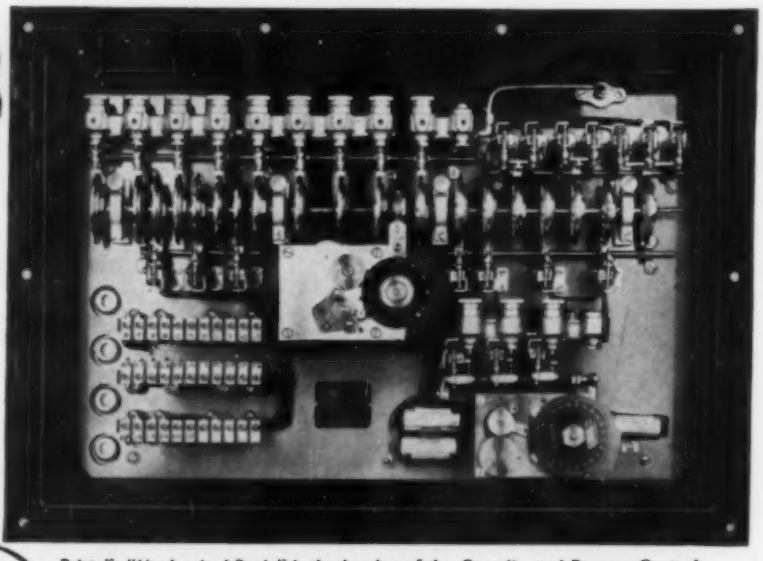
(Continued on page 78)

The *Modern* Answer To

When Bristol's Your Chemical



Bristol Coordinated Control System automatically controls operation of "Columbia" Activated Carbon Solvent Recovery Plant at the New York Daily News. Similar control systems are used in many other solvent recovery plants designed and supplied by Carbide & Carbon Chemicals Corporation, New York, N. Y.



Bristol's "Mechanical Brain" is the leader of the Coordinated Process Control System . . . accurately coordinating all the variables so that each phase of the process takes place in proper sequence.

AUTOMATIC CONTROLLING AND

Higher Processing Costs!

"Mechanical Brain" Master Minds Processing, You Get:

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- **NEW STANDARDS OF PLANT EFFICIENCY**
- **UNIFORMLY HIGH PRODUCT QUALITY**
- **INCREASED PRODUCTION FROM PRESENT EQUIPMENT**

Bristol's Greatest Contribution To Industrial Process Efficiency

What It Is . . . Bristol's System of Coordinated Process Control culminates 59 years of precision instrument making. It is an engineered combination of automatic control instruments built in the form of a master control station. It controls, coordinates and interlocks all the vital variables in the processing cycle so that each takes place precisely *when* it should and *how* it should. A Bristol Cycle Controller acts as the "mechanical brain", coordinating all the other instruments. The system is shipped completely assembled, requiring only main power and air connections to put it to work in your plant.

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For every industrial process there is one set of conditions which produces the best results. These conditions can be achieved in the laboratory or pilot plant, but usually with difficulty in actual production. With Bristol Coordinated Control, the exact "formula", sequence of operations and degree of control necessary for maximum plant efficiency, product quality and uniformity can be transferred to the production stage with mathematical precision. The control system holds processing to the proper schedule and maintains the set of conditions known to produce the best results . . . automatically. The apparatus is extremely flexible. Processing schedules are easily adapted to changing conditions.

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With costs up all along the line, processing efficiency is more important than ever in securing competitive advantage. Bristol's Coordinated Process Control System is the most modern, most effective way to meet the challenge of rising costs . . . to secure new margins of profits . . . to open up new productive horizons. Each installation is separately engineered to the requirements of the process involved. Write for further information. THE BRISTOL COMPANY, 109 Bristol Road, Waterbury 91, Conn. (The Bristol Co. of Canada, Ltd., Toronto, Ontario. Bristol's Instrument Co., London N. W. 10, England.) Hundreds of installations in successful operation. Write for list of users.

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Bristol has hundreds of recording and controlling instruments as well as pyrometers and thermocouples *in stock* for immediate delivery. Send for Bulletin W1811 Stock Instruments, and Bulletin P1235 Thermocouples and Pyrometer Accessories.

Engineers process control for better products and profits

RECORDING INSTRUMENTS

(*Continued from page 75*)

funds made available under the Synthetic Liquid Fuels Act.

•

Munitions Board survey of the nation's industrial facilities will include chemical plants. Initially, about 11,000 plants will be surveyed; eventually, two or three times that number. Top military planning body for mobilization, the Board has set itself a twofold objective: to determine what each plant can produce quickly and efficiently for war use with minimum changeover; and to assign tentatively output of each plant to a branch of the service.

•

Blanket deferment of scientists will not be included in any draft legislation. Instead Congress proposes that the President handle the scientific manpower problem administratively, with the National Security Resources Board formulating top policy on deferments for technical men. The lawmakers would like to see special boards set up to process appeals of individual scientists.

•

Finding dollars for expansion of the chemical industry has become increasingly difficult in the face of high taxes. This is the message that their president, Charles S. Munson of USI, had for MCA members meeting earlier this month at Skytop in Pennsylvania. The increased cost of doing business in an inflationary economy has forced the chemical industry to plow back profits and to increase the total of preferred stock and funded debt. Even long-term loans from insurance companies and banks, Munson believes, are not going to be so easy to get from now on. At present, chemical companies find common stock financing almost impossible. High taxes have dried up the sources of risk capital.

Chemical industry, Munson contends, is bumping its head against a financial ceiling. His explanation: the wide disparity between sharply increased costs and moderately higher chemical prices. While wage rates, commodity prices and construction costs have all climbed more than 80 percent since 1939, prices received by the industry for chemicals are up only 32 percent over that year.

There is a limit to the plowing back of profits. In 1947 the biggest single source of new money was the industry's own profits. This will probably be true again this year. As Munson points out, however, the $500 million currently available in undistributed profits, even together with an added $200 million in depreciation reserves, is not enough to meet expansion needs.

Funded debt of the 11 largest chemical companies (representing 40 percent of the entire industry) has grown from $50 million at the end of 1939 to $350 million at the end of 1947. Most of this increase occurred last year. Preferred stock of these companies has also increased, indicating a forced change in the chemical industry's traditional method of expansion by sale of common stock. In 1939 the total of funded debt and preferred stock of these companies was $250 million, compared to $550 million in common stock. At the end of 1947 their total of debt and preferred was $700 million, with less than $600 million in common stock.

Unless the dollars to translate research ideas into new processes and new products are forthcoming, the chemical industry is in for trouble. Under present conditions, Munson warns, a return to common stock financing is highly improbable. Recently, whenever a common stock issue has been floated, the market has reacted and the value of the outstanding shares has declined about 20 percent. But common stock financing is essential to continuing progress in the chemical industry.

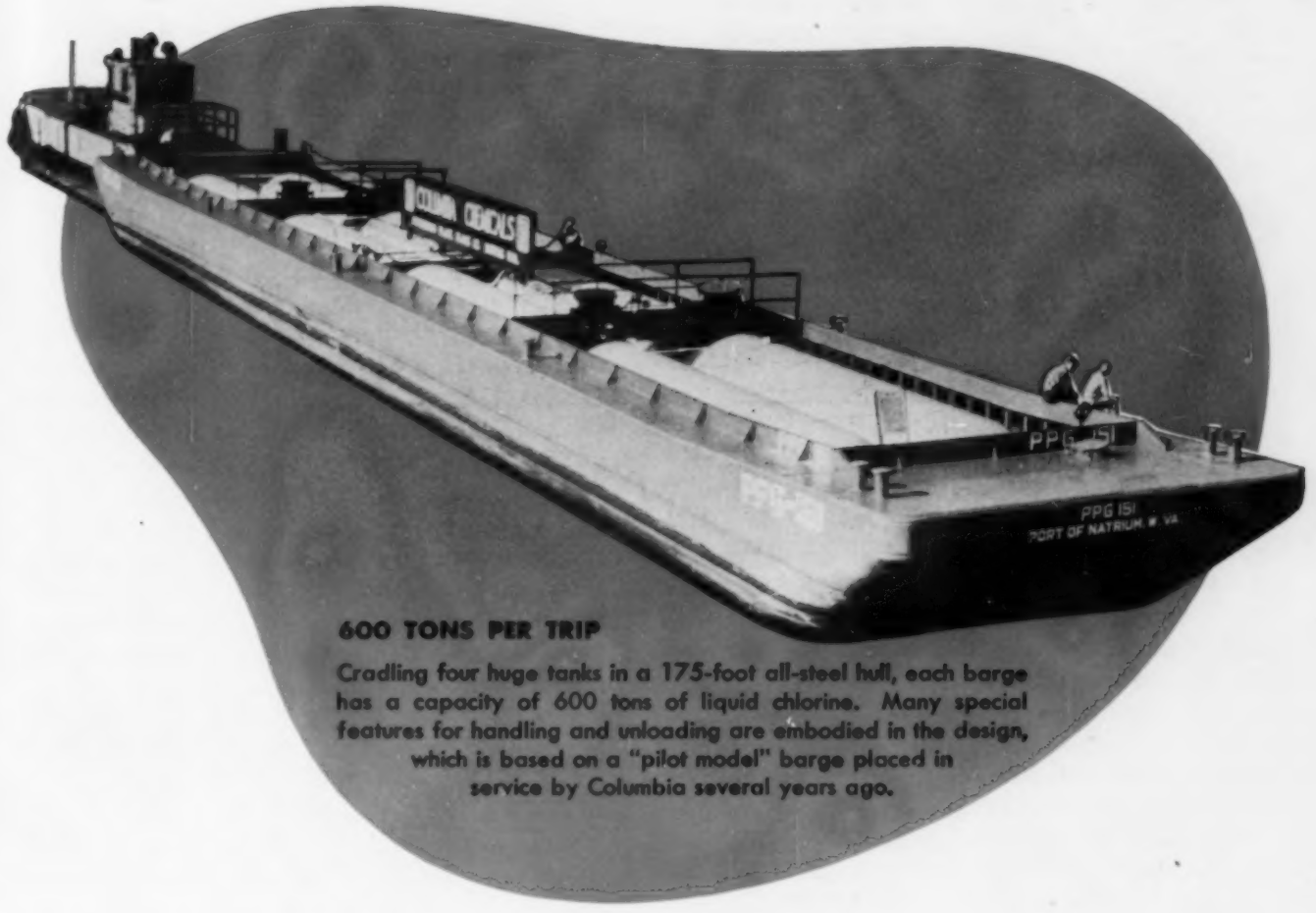
The basic remedy lies in the revision of the tax structure. Munson advocates elimination of double taxation (through taxes on dividends) and he calls for reduction of the tax rate to stimulate investment by individuals with funds in excess of consumption needs. As a result of confiscatory surtaxes, Munson declares, investors as a class have become all but extinct.

•

Flurry of strikes has affected some chemical companies. A strike of 300 AFL Chemical Workers at the Natrium, W. Va., plant of Columbia Chemical Division of Pittsburgh Plate Glass began May 11 over wages. Columbia has also been struck since April 11 at Barberton, Ohio, by the United Mine Workers, District 50, with 1,600 workers involved. At South Point, Ohio, the Solvay Division of Allied has a strike of 450 CIO Steelworkers on its hands. The strike began May 1 over new contract negotiations with wages a big factor. And Commercial Solvents has been having its own labor headaches in the Middle West. In the package veneer industry in western Washington and Oregon about 240 CIO Woodworkers went out April 14 demanding an increase in pay. The strikers recently voted on an offer by management.

With the cost of living still climbing, workers are feeling the pinch. Hence demands for wage increases have touched off most of these strikes. Many employers in the chemical, oil and plywood industries have granted boosts. Pay increases have

Record volumes of Chlorine shipped via waterways



600 TONS PER TRIP

Cradling four huge tanks in a 175-foot all-steel hull, each barge has a capacity of 600 tons of liquid chlorine. Many special features for handling and unloading are embodied in the design, which is based on a "pilot model" barge placed in service by Columbia several years ago.

Fleets of chlorine barges—the first ever designed specifically for this service—have been transporting record quantities of chlorine from Columbia's plant at Natrium, West Virginia . . . and from the plant of its affiliate, Southern Alkali Corporation, at Lake Charles, Louisiana. Operating along the Ohio-Mississippi inland waterways and the inland waterways system of the Gulf Coast, these chlorine barges provide obvious advantages to large-volume users of chlorine in these areas. They are among the most recent examples of the progressive service rendered by Columbia-Southern, the nation's largest merchant producers of chlorine. Pittsburgh Plate Glass Company, Columbia Chemical Division, Fifth Avenue at Bellefield, Pittsburgh 13, Pennsylvania.

COLUMBIA CHEMICALS

CHICAGO · NEW YORK · BOSTON · CINCINNATI · MINNEAPOLIS · CHARLOTTE · ST. LOUIS · CLEVELAND · SAN FRANCISCO · PITTSBURGH · PHILADELPHIA

PAINT · GLASS · CHEMICALS · BRUSHES · PLASTICS

PITTSBURGH PLATE GLASS COMPANY

ranged from 6c. to 13c. an hr. But no pattern has emerged. Northwest Plywood settled with the CIO and AFL for 5c. an hr. (added to 7½c. an hr. granted at year's beginning). This strike had affected 40,000 workers. Union trouble often arises when an employer refuses to grant the same increase that other employers in the industry or in the area have granted.

•

Union shop authorization polls may be dropped as an unnecessary burden on the election machinery of NLRB. The Senate-House watch-dog committee under the Taft-Hartley Law heard many witnesses urge such action. One witness, Louis S. Belkin of Akron, Ohio, attorney for the AFL Chemical Workers, testified that, instead of weakening union security, the Taft-Hartley Law has actually strengthened the union's chances of getting a union shop from management. This is because in almost every case the workers vote for a union shop by a wide margin. When union negotiators confront management with this fact at the bargaining table, it becomes difficult for management to resist granting a union shop. Even so, Belkin urged dropping the election procedure as an "inexcusable extravagance."

•

Pulp and paper industry has its share of unsolved problems, many involving color. Use of groundwood pulp, for example, is limited by the fact that it darkens on exposure to light. And if the chemical nature of the coloring matter in kraft pulp could be determined, bleaching costs would be reduced. Overcoming the pink coloration of Western hemlock and ground sulphite is another tough problem. These are challenges that the pulp and paper makers have taken up.

•

Enrichment of iron ore is being considered as a project for the lignite research laboratory of the U. S. Bureau of Mines, to be built at the University of North Dakota in Grand Forks. When the new laboratory gets going, it may take up the problem of how to beneficiate low-grade Minnesota iron ore, using gases from lignite. For its investigation of synthetic liquid fuels, the Bureau already has at the university a pilot plant making hydrogen and carbon monoxide.

•

Fischer-Tropsch process for making synthetic liquid fuels from natural gas, reports Dr. H. H. Storch of the U.S. Bureau of Mines, has been on its economic feet a scant half year. Climbing price of crude oil put it there. But it is nip-and-tuck between crude and natural gas prices. Long-term contracts for natural gas are written today at prices as high as 11c. per Mcf. If the price of natural gas goes to 15c. without a corresponding rise in crude, warns Storch, synthetic fuels from natural gas will be knocked off their economic underpinnings by fuels from crude oil.

Furthermore, it will then be just as cheap to make synthetic liquid fuels from coal as from 15-c. natural gas. So Storch does not expect any rush to build Fischer-Tropsch plants. But he does find commercial interest in the Oxo process due to its detergent and plasticizer possibilities.

Where crude oil cannot be delivered by all-water transportation, coal hydrogenation is economically feasible now. But competition from petroleum products, Storch points out, initially will limit output to fuel oil. It is still cheaper to make motor and aviation gasolines from petroleum.

For the tar acids, tar bases, olefins, aromatics and saturates coming from coal hydrogenation plants there are, according to Storch, possibilities as solvents, lacquer thinners, wood preservatives and pharmaceutical raw materials.

If enough byproduct alcohol comes from synthetic liquid fuel processes to bring its price down as low as 12c. a gal., Storch foresees alcohol replacing petroleum as a source of butadiene for the synthetic rubber industry. The byproduct alcohol might also find its way into other chemical processes.

•

Nitrogen fertilizer shipped abroad instead of wheat can save American taxpayers as much as $256 million this year. One ton of nitrogen produces 12 to 15 tons of grain abroad. With nitrogen at $200 a ton and wheat at $86 a ton, each ton of nitrogen shipped overseas represents a saving of $800. Fertilizer shipments have had little influence on price. Nitrogen production in Germany and Japan and in Army plants in the United States needs to be stepped up. Lack of funds has crippled Army attempts to add 112,000 tons a year to current annual output of 260,000 tons in its plants. Perhaps WAA should sell or lease the plants to industry.

•

Electric power demands of the aluminum industry are enormous. To push production of that metal, the Big Three among producers have been searching for added sources of electricity. A trend is emerging. Where waterpower is unavailable, the aluminum producers are going over to natural gas in their generating plants.

As the white outline indicates, a standard unit of much greater frame size would be required to do the work of Speedaire.

Floods of suds don't disturb SPEEDAIRE

THIS Speedaire drives a stock chest agitator in a paper mill. The two airducts or ventilators on the motor protect it against drenching during the daily washdown with water. Foam from stock and black liquor, which sometimes builds up as high as 8 or 10 feet during starting, is no handicap to Speedaire, as its efficiency is unaffected by either moisture or dust.

Compared to a conventional worm gear drive of the size required to do this work, Speedaire occupies 30% less space and weighs 200 lbs. less. Speedaire saved $156 in installed cost.

Speedaire is Cleveland's new fan-cooled worm-gear speed reducer. Because it is fan-cooled, Speedaire will do more work—will deliver up to *double the horsepower* of standard worm units of equal frame size, at usual motor speeds. It can be installed economically on many applications where other types have been used heretofore—giving you the advantages of a compact right-angle drive. Speedaire gives the same long, trouble-free service characteristic of all Clevelands.

Send for Catalog 300 for a full description. The Cleveland Worm & Gear Co., 3273 E. 80th St., Cleveland 4, O.

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CLEVELAND
Worm Gear
Speed Reducers

First to look for more kilowatts, Alcoa will be first to get them. It will build a new reduction plant on the Gulf Coast at Point Comfort, Tex., near Port Lavaca and between Houston and Corpus Christi. Alumina will come by barge from Alcoa's Mobile, Ala., works to the docks at Point Comfort. To be completed in two years, the new plant will turn out 70 million pounds of aluminum a year. Generating equipment will have an 80,000-kw. installed capacity. Power will be made on the spot, with natural gas from the nearby Refugio field as fuel for the turbines. Gas-electric power costs more than hydroelectric power. But cheap barge delivery of the bulky alumina will probably counterbalance added power costs.

Kaiser's Permanente Metals Co., winding up its power survey in the Southwest, will soon come up with its solution to the kilowatt shortage. This will probably entail expansion of its Baton Rouge, La., alumina plant to include pot lines for aluminum. Here too, power would be generated on the site, again with natural gas as the fuel. But getting enough gas to run the generators is a big order. And both Kaiser and Alcoa may have trouble getting the power equipment.

Reynolds Metals, third of the big producers, so far unable to find a means of making more kilowatts on its own, will have to wait until next year for enough power to turn on its two idle pot lines at the Jones Mill, Ark., plant. This will come from the Arkansas Power & Light Co., which is completing a war-surplus power plant at Lake Catherine. Unlike the other two companies, however, Reynolds probably will boost its production first.

•

New aluminum plant of Alcoa in Texas will be erected near Port Lavaca, not at Corpus Christi. When full-scale operations get under way, the plant will employ between 400 and 500 persons. Thus Corpus Christi's loss is Port Lavaca's gain. William H. Bauer and his partner, H. C. Smith, worked for 10 months to get the plant for Port Lavaca. When Alcoa finally decided to locate there, it purchased the 3,000-acre site from their company, the Bauer-Smith Dredging Co.

To Jeff Bell, manager of the Corpus Christi Chamber of Commerce, who had worked with Alcoa officials for more than a year during the plant location studies, the Alcoa officials gave two reasons for the decision to bypass Corpus Christi. Prime reason for rejecting the Corpus Christi location was the failure to find a 3,000-acre site at a "reasonable" price. The other consideration was the uncertainty about the water supply. The Nueces River flow is more than sufficient to supply all the water needed for industrial uses, but reservoir facilities are limited. For civic bodies eager to attract industry, here are two lessons. The sharp practice of holding out for a higher price on industrial property may boomerang. And failure to provide adequate reservoir facilities is shortsighted.

•

New synthetic fiber jointly developed in Great Britain by the Calico Printers Association, Ltd., and Imperial Chemical Industries, Ltd., is polyethylene terephthalate. Terylene, as it called, is a fabric with properties similar to nylon. But there have been difficulties in dyeing it. Even in England its use has not become widespread. And in the United States its introduction lies in the future.

Terylene is made from terephthalic acid and ethylene glycol. Terephthalic acid is obtained during the manufacture of phthalic anhydride from petroleum. Phthalic anhydride in enormous quantities goes into dyes, plasticizers and resins. While production of phthalic anhydride from petroleum is limited at present, it is growing steadily. So more terephthalic acid should become available in the future. About 230 million pounds a year of ethylene glycol are produced from petroleum. Most of it goes into permanent antifreeze. New ethylene glycol plants, however, are under way.

Terylene resin is melt-spun into fiber. In England this now is done in full-scale equipment. Melt-spinning, developed by Du Pont for nylon, requires no solvent. Chips are supplied to the spinning head, heat applied, molten fluid pumped through a filter and extruded from a spinneret. But the melt-spinning of Terylene is complicated by its high melt-viscosity, which is much higher than that of nylon.

Terylene fabrics have a warm feel. Stable to light, they resist mold and bacteria. Their high wet strength makes them launder well. They withstand dry-cleaning solvents, dilute acids and bleaching agents. But they are hard to dye. Uniform and fast pastels have been achieved, but new dyes or dyeing techniques may be required.

For some uses no dyeing is necessary. Thus ICI plans to make heavy industrial cords, as well as low-twist yarn similar to silk. Terylene may find a market with tire manufacturers. To get staple for processing on cotton and wool textile machinery, Terylene filament is cut into short lengths. Price and performance will determine how competitive Terylene is with cotton, nylon and high-strength rayon. Already Du Pont is exploring production processes and possible applications.

prevailing standards, and not very severe standards at that, for persons holding their posts.

The salary crisis, however, is easing.

III

But now comes the new crisis in school buildings and equipment.

We would have been hard put to get our schools back into shape after years of wartime neglect—even without a booming birthrate complicating the problem. Right now, 85% of all public school buildings need major remodeling to remove health and safety hazards.

And we aren't building enough new schools to keep up with current needs, to say nothing of catching up on those we were not able to build during the war years. School construction expenditures for 1948 are estimated at $375 million – which is less than what was spent in 1939. With building costs twice as high as they were in 1939, that means we aren't even holding our own—we are falling further behind.

And now comes the rush of war babies.

IV

We must spend at least $11 billion on new schools and equipment in the next decade.

Public and elementary schools must have $6.6 billion. Equally important, another $4.4 billion must be invested in buildings and equipment in our private schools, colleges and universities if they are to meet the demands which will be made upon them. The private school and the privately endowed university are doing their full share and doing it well. The need for them is increasing.

These figures cover only rockbottom needs for educational plant and equipment. But statistics are a very restricted recorder of this crisis.

You can see it better, I'm sure, in schools not very far from your home. There are schools with leaking roofs and outdoor toilets in our greatest cities. There are schools where students still use histories and geographies copyrighted before 1920—books with no mention of World War I, the depression of the 1930's, the Russian Revolution or the rise of the dictators. There are countless schools where modern methods of visual education are completely unknown.

All of these conditions promise to get worse—promptly—as that scheduled 5 million increase in the school population gets rolling.

V

The Metropolitan Life Insurance Company does not indulge in lurid prose. It says after painstaking study of the educational crisis that:

"Unless definite measures are taken immediately . . . large numbers of American boys and girls will be deprived of an adequate education."

Currently we are deeply concerned about our military defenses. We are taking, and I think rightly, emergency measures to strengthen them. But we must regard our schools as a part of our national defense as vital as are our armed forces. This is particularly true in these times of fifth columns and ideological warfare.

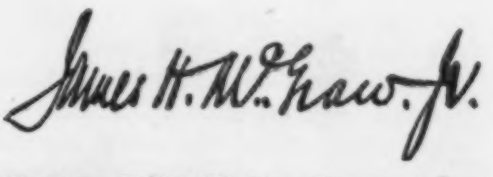
If we are wise, we will raise our sights. We will give the continuing crisis in education the same urgent attention being given the more obvious but no more real crisis in national defense.

Go to the school house in your neighborhood and discover what needs to be done to provide for the rising tide of young Americans. Ask your school board and your school administrators and teachers how you can help them.

That is good citizenship.

That is patriotism.

That is our duty to the oncoming generation.



President, McGraw-Hill Publishing Company, Inc.

THIS IS THE 68TH OF THE SERIES

CHEMICAL ENGINEERING
with CHEMICAL & METALLURGICAL ENGINEERING

ESTABLISHED 1902 JUNE 1948 SIDNEY D. KIRKPATRICK, Editor

War Lessons We Failed to Learn

CONGRESS seems sorely in need of a refresher course. Too many of the lessons learned so painfully as a result of war experience have been forgotten. One that we thought of No. 1 importance in August, 1943, was the realization that our destiny as a nation depends on the use we make of science and technology. On this page then we said "If in spite of our ideals, we are to be challenged periodically by enemies who have plotted our destruction, then practical idealism calls for preparedness. It calls for a realization that we must never again neglect the things that are most important for our national defense. Research is certainly one of these. So, too, is the necessity for continuing the education of qualified students in science and engineering, on whom we must ultimately depend for national health, progress and security."

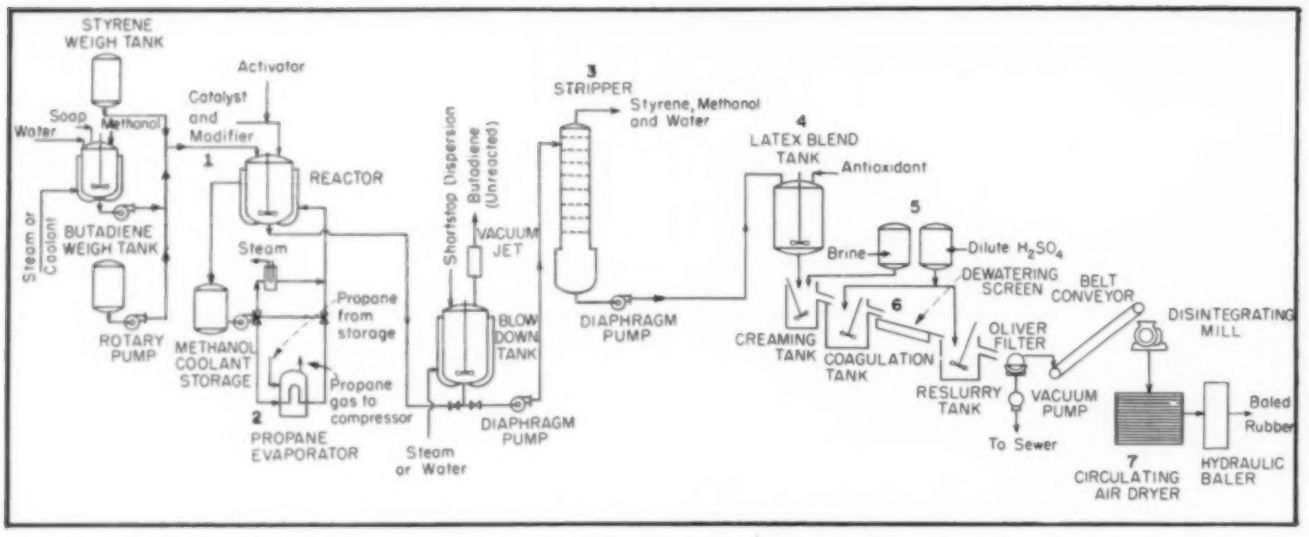
During the war we talked a lot about strategic resources—about certain metals and minerals for which our need far exceeded the national supply. We were determined to do something about them when war was over. So Congress passed a law setting up the National Security Resources Board and appropriated money for a long-time stock piling program. Having done as much for strategic metals and minerals, it was only logical to expect comparable conservation of strategic manpower. So far we have waited in vain. Instead, Congress went back almost to Civil War days in drafting its selective service legislation which, it seems to us, fails to provide adequately for efficient utilization of the talents of our human resources.

The chemical profession stood squarely behind President Charles Allen Thomas of the American Chemical Society in his vigorous pleas for safeguards against draining off scientists and technologists into non-scientific work. We applaud his statement: "The induction and assignment of promising scientific students to nonscientific jobs in the Armed Forces has in effect created a lost generation of scientists, so that at the present time we find our supply totally inadequate. If a draft law is put into effect which totally disregards this important fact . . . we will veritably commit scientific suicide."

Chemical industry also supported the brief Dr. Norman A. Shepard presented on behalf of the Manufacturing Chemists' Association. He argued, apparently in vain, for a board of technically trained individuals completely familiar with the country's needs. This would be set up on a national level with policy-making authority over all occupational deferments in the scientific and technological fields, including medicine. Instead, the indications at this writing are that deferment policies will again be set by the Director of Selective Service with no clear understanding that advice will be sought from other than the military authorities.

Any further fanning of the flame of controversy between the pro-military and pro-civilian blocs in Congress is certain to affect other pending legislation and presidential appointments. For awhile it looked as though a veto-proof version of the bill to create a National Science Foundation was certain of passage at this session. Now there is grave doubt about some of the compromised features in S. 2385 as passed by the Senate and currently awaiting consideration by the House. Adding to the confusion is the threatened return of administrative amendments on which the White House has already expressed its opposition.

So it seems that science and scientists may again suffer defeat and delay in the slow process of educating our elected representatives in the Congress. The prospect is discouraging, to be sure, but we have nothing to fear once we have thoroughly aroused the electorate to a realization that "our destiny as a nation depends on the use we make of science and technology."



Improved low temperature processes have been developed in Phillips Petroleum Co.'s . . .

Synthetic Rubber Pilot Plant

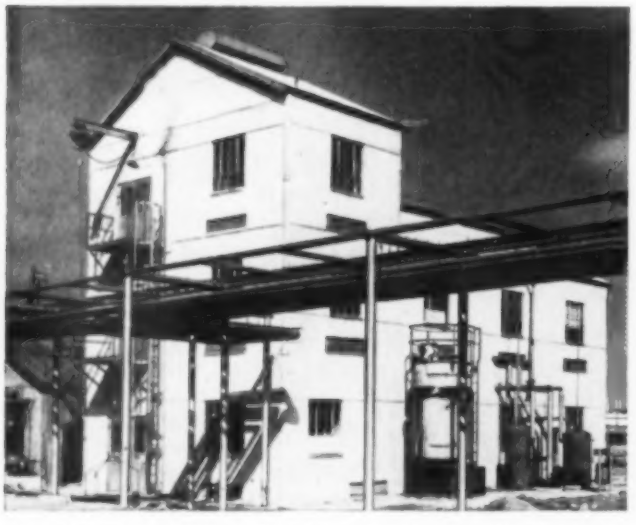
Designed in 1942, Phillips pilot plant has been making low temperature rubber following methods suggested or developed in this country and Germany.

J. V. Hightower
Southwestern Editor,
Chemical Engineering

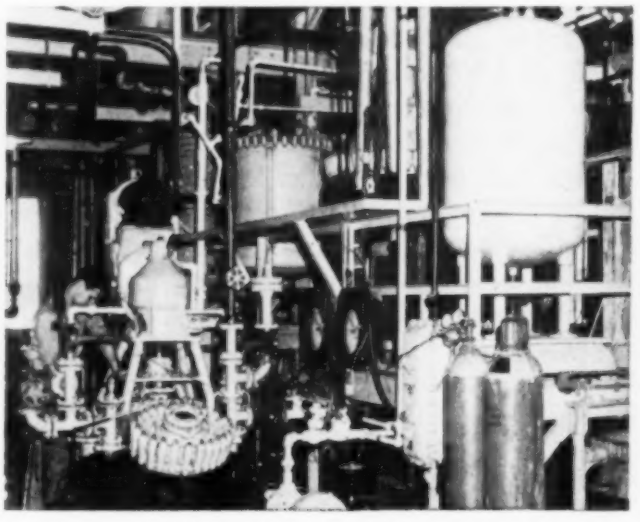
Soon after the United States was plunged into the war, Phillips Petroleum Co. decided to build a pilot plant to investigate low-temperature polymerization of synthetic rubbers. The unit, designed in 1942, with one reactor of 260 gal. capacity and several smaller reactors, was the first large pilot plant in the country to handle emulsion temperatures as low as 0 deg. F.

The plant went into operation at Phillips, Tex., in 1944. The wide range of temperatures which its refrigerated reactor can handle has made it possible to explore the various low-temperature polymerization recipes which the Germans, the Office of Rubber Reserve and Phillips have developed or suggested.

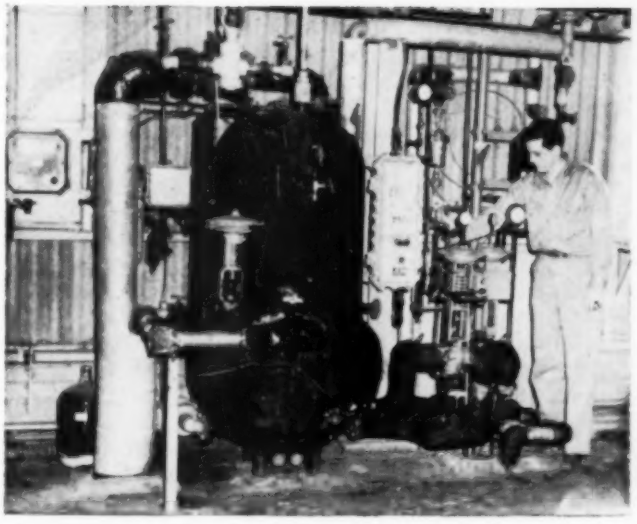
The plant has produced over 50,000 lb. of rubber crumb. Most of this has been a polymer produced at



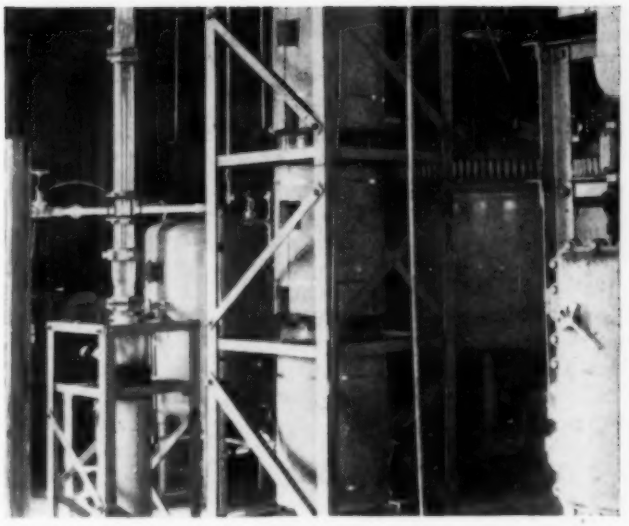
In pilot plant, Phillips Petroleum Co. developed its process for low temperature polymerization of synthetic rubbers.



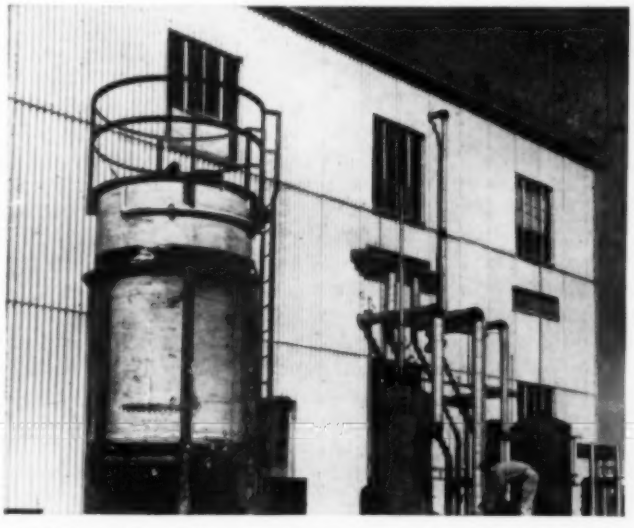
1 Styrene, butadiene and soap solution from weigh tanks are charged to the 260 gal. polymerization reactor.



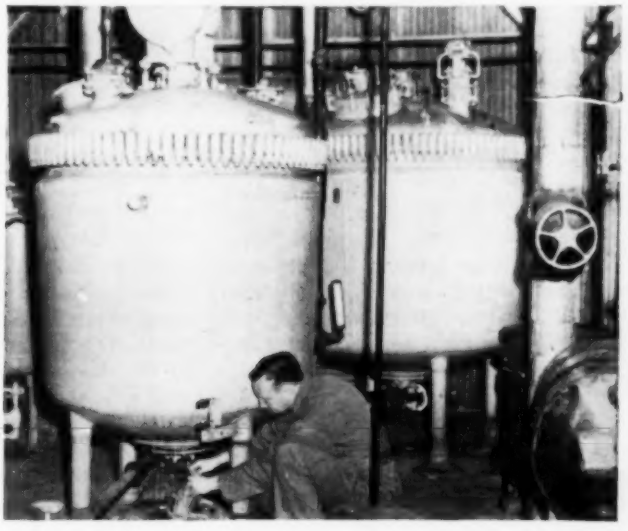
2 Coolant circulates through the jacketed reactor after it is refrigerated in this propane evaporator.



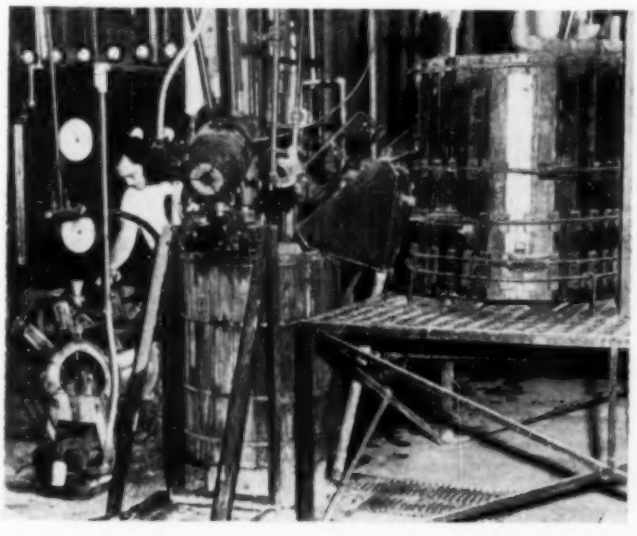
3 Unreacted styrene is steam stripped from the latex in this insulated pyrex column operating at about 100 mm. Hg abs.



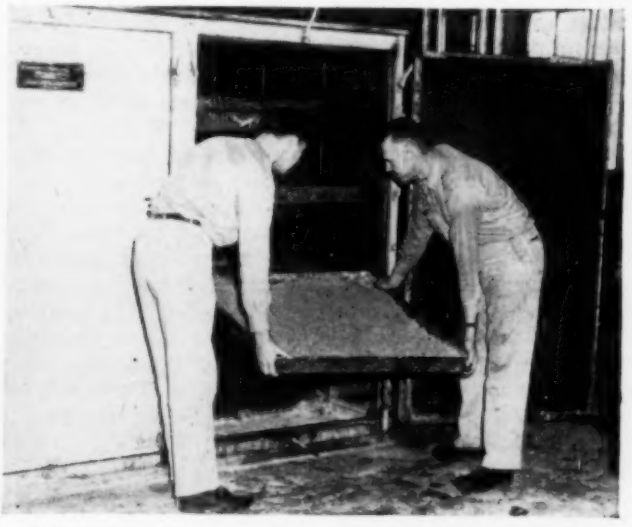
4 Stripped latex is pumped to the 1,500 gal. glass lined blending tank where antioxidant is added.



5 Two storage tanks contain the salt solution and dilute sulphuric acid used to coagulate the latex.



6 Latex is continuously processed. Right to left: coagulation tank, dewatering screen, reslurry tank and filter.



7 Washed filter take passes to a disintegration mill then to air dryer. Dried rubber crumb is later pressed into bales.

a reactor temperature of 41 deg. F., and designated Philprene A, and a product polymerized at 14 deg. F., designated Philprene B.

The low-temperature flexibility of the pilot plant has proved an advantage in making it possible to investigate on a large scale some "fast" recipes that became available in the last few years. Substantial quantities of Philprene A were made in 1946. Early in 1947 the company used antifreeze agents in recipes processed in this equipment to produce rubbers at reactor temperatures of 14 deg. F. and below.

How Pilot Plant Works

As to how the pilot plant operates: One of the first stages removes the tertiary butyl catechol (polymerization inhibitor) from the butadiene and styrene raw materials entering the plant. The butadiene enters a batch still (carbon steel) which moves the purified product overhead, through a condenser, and into a 100-gal. weigh tank. The styrene passes through a carbon steel caustic wash tank in a centrifugal pump circulation system and is allowed to settle. After settling and withdrawal of caustic solution, the styrene receives a water wash and goes through a centrifugal pump to a 100-gal weigh tank.

Soap make-up is another job going on preparatory to charging the polymerization reactor with butadiene and styrene. A measured amount of the soap (fatty acid or rosin type) enters a 250-gal. glass-lined vessel, jacketed to permit steam heating or cooling with water or methanol. Water flows through a rotating disk meter into the vessel. If methanol is required in the reaction, as when making 14 deg. F. rubber, methanol enters the vessel also. An anchor-type impeller provides agitation for the mixture.

The solution leaves the soap make-up vessel through a rotary pump and thence into a 260-gal. polymerization reactor. Activator solution is then charged to the reactor from a 20-gal. glass lined pot. Next, styrene enters the reactor from the styrene weigh tank. Finally, butadiene passes from its weigh tank into the reactor. The reactor is then agitated and the temperature is brought to the required point, at which time the catalyst, an organic hydroperoxide or diazo thio ether, is charged to the vessel from a bomb pressured with nitrogen.

It is necessary to exclude air from the reactor system in order to avoid its effect on the rate of polymerization and quality of product. When the reactor operates at 14 deg. F. a positive pressure of nitrogen is maintained. However, at 41 deg. F. operation the pressure in the system is sufficiently high not to require pressuring with nitrogen.

Reaction temperature is controlled by a recorder controller system which operates two three-way motor valves governing the blending of (1) refrigerated coolant, (2) steam heated coolant, and (3) coolant pumped from storage directly to the reactor without refrigeration or heating. The coolant is a methanol-water solution.

Refrigeration occurs in an evaporator containing a vertical heat exchanger in which liquid propane is boiled at constant level. The coolant is moved from storage into the tubes of this evaporator and thence to one of the three-way valves before entering the jacket of the reactor. The outlet temperature of the coolant leaving the evaporator is controlled by controlling the pressure of propane in the evaporator.

The propane system furnishing the refrigeration consists of a 300-gal. liquid propane storage tank insulated with mineral wool, a surge tank receiving propane gas from the evaporator, a reciprocating compressor and a condenser after the compressor. A steam coil around the bottom of the mineral wool insulated surge tank prevents accumulation of liquid propane in this tank.

In the reactor, conversion ranges from 60 to 70 percent of the combined weight of the butadiene and styrene entering. The latex is sampled periodically and the results of the analyses are extrapolated to determine the time of blow-down of the reactor batch to give the desired conversion. A reaction time of 12 to 18 hr. is the range covering the production of 14 deg. F. and 41 deg. F. rubbers. Investigations are being made to determine quality of product at higher percentage conversions.

At the end of the reaction period, the latex is discharged by gravity from the base of the reactor into the bottom of a 500-gal. glass lined blow-down tank. There, polymerization is stopped by the addition of a shortstop dispersion consisting of di-tertiary butyl hydroquinone in water along with a dispersing agent. Unreacted butadiene is removed from the latex by drawing a vacuum on the vessel while agitating. By feeding steam or water into the jacket of the blow-down tank, the temperature is gradually raised to 100 deg. F.

A diaphragm pump moves the latex and unreacted styrene from the tank to a 12-in. Pyrex stripping column operating at about 100 mm. mercury abs. pressure and containing nine perforated glass plates. Steam moving up through the column strips the styrene from the descending latex. If methanol is present, as when producing 14 deg. F. rubber, it is also stripped out along with the styrene. The vapors leaving the top of the column pass through a water cooled condenser; the condensate then enters a styrene decanter, which is a steel tank where styrene collects as the upper phase and water (or water plus methanol) as the lower phase.

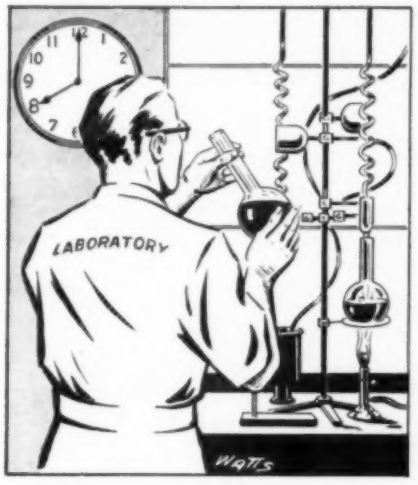
The stripped latex moves through a diaphragm pump from the base of the stripper into the top of a 1,500-gal. glass lined latex blending tank. Here, phenyl beta naphthylamine dispersed in water is added as an antioxidant to stabilize the latex during subsequent processing.

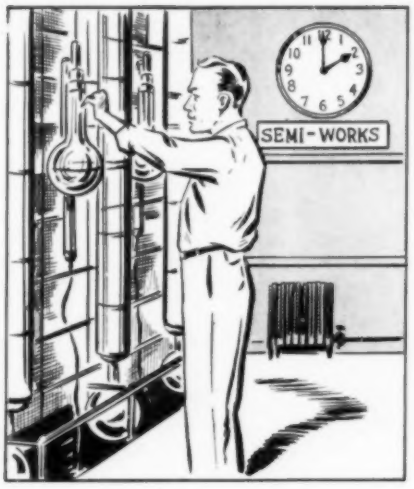
Coagulating the Latex

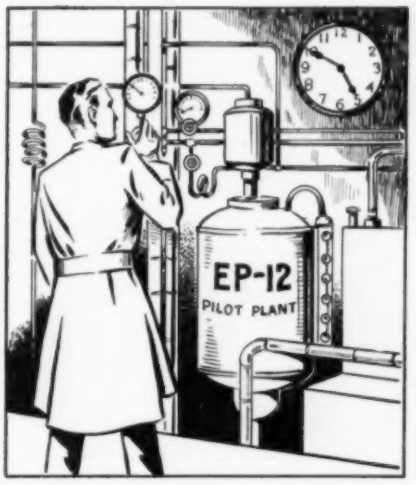
The latex is pumped from the blending tank to the coagulation unit, then passes through a metering valve and enters a 10-gal. creaming tank, where it is creamed with a 10 percent (wt.) sodium chloride solution with vigorous agitation. The creamed latex overflows continuously into a coagulating tank, a 100-gal. wooden tub. Coagulation occurs when a dilute sulphuric acid solution (0.5 to 1.0 wt. percent) is added. The salt and acid solutions are prepared in glass lined, agitated storage tanks.

Slurry overflows from the coagulating tank upon a stainless steel dewatering screen through which drains the salt-acid serum into a sewer. The rubber crumb retained on the screen is washed with treated water into an agitated 100-gal. wooden reslurry tank, where the pH is adjusted to 3-5 by addition of sulphuric acid solution. The mixture of crumb and acid water overflows to an Oliver filter where the acid water is removed by vacuum. The filter cake receives a water wash afterward.

The cake, after passing through a pressure roll, then moves on a rubber conveyor belt into a Jeffrey disintegrating mill. Crumb is removed by gravity from the mill and is collected on stainless steel perforated trays which are placed manually in a circulating air dryer. This dryer has a capacity of about 500 lb. of crumb on the 16 trays. The material is dried at 160 deg. F. for about nine hr. The dried crumb is pressed into bales weighing from 10 to 30 lb. in a Samsco hydraulic baler before being shipped to processors.







In Chemical Process Development . . .

TIME=MONEY

More research time means cheaper, better plant. But delay in construction date cuts profits, shortens plant's life. Problem is finding optimum time.

H. L. Barnebey
Blaw-Knox Co., Pittsburgh, Pa.

One characteristic of the chemical industry, which sets it apart from other industries, is that its products and methods of making them are constantly changing. This makes life interesting—and complex. This rapid evolution influences thought and sets the pace for action.

A chemical company cannot afford to sit still, making the same products in the same way year after year. More wide awake organizations with progressive managements will, through timely developments, sell better materials for lower prices. Each company must be constantly preparing for the future by developing new products and new ways for making present ones.

Most articles on process development are concerned primarily with engineering matters and cost. This one deals with *time*. Timing is the essence of a development program.

Time and money, like matter and energy, are interchangeable under certain conditions, or convertible one into the other. If an established or potential market for a new material exists, a production plant in operation today is worth a certain amount of money. A year from now it is probably worth somewhat less. In ten years it may be almost worthless.

The total cost of an operating plant is made up of three parts: the cost of developing the process, the cost of building the plant, and an item of contingency which takes care of the unknown factors. If a plant is built from very meager data, the cost of development is small, but the contingency is disproportionately high. As time goes on and process improvements are worked out, the development cost goes up and the contingency comes down. The total plant cost, or the sum of these items, should decrease as time is spent improving the process.

Within reasonable limits, spending time on a development program reduces the overall cost of the completed plant project. But as times goes by, the plant is worth less and less as a potential producer of income. So, there is an optimum time to stop the process evolution and build the plant. Since the figures are based on many assumptions, determination of the optimum time is approximate, but it can give worthwhile guidance.

Those in charge of a development program should have the over-all picture in mind, and look at all the parts in proper perspective. They should not become so engrossed in minor details that they lose sight of the main plan. In making major decisions, business judgment means more than engineering judgment.

Program Management

A development program can be managed in two basic ways. One group can handle the whole project from research through engineering of the final plant, or the job can be handed from group to group as it goes from one phase to the next. The former is employed in small companies, the latter in large ones. There are advantages to each method and sometimes a desirable combination can be worked out.

Some projects can be started far enough in advance so that there is sufficient time to handle them in a way most economical of money and manpower. If plenty of time is available—use it. A small number of people, following the entire program through step by step will handle it most efficiently. The more time that is available, the better the development job can be done, provided the work is properly planned.

Managing a development program in a systematic way will save both time

and money. It is helpful to break down the work into a number of separate and clearly defined steps. For many projects a series of six steps seems to work out very well. These are:

Program Steps

1. *Laboratory Research* — Starting with the conception of the idea, trying it out in ordinary laboratory equipment, and ending with a general background of facts relative to the process.
2. *Product Evaluation*—A cost and market study to determine whether the new product or process is worth developing.
3. *Process Study*—An experimental study of the individual processing steps to obtain qualitative indications and determine equipment types.
4. *Preliminary Engineering*—Tentative approximate design and cost estimate of the commercial plant, based on present knowledge, to decide whether it will make a good profit and warrant proceeding further.
5. *Pilot Plant Study*—The design, construction, and operation of a pilot unit to obtain the quantitative data required to build the production plant visualized in the previous steps.
6. *Commercial Plant*—Building the large plant and conversion of development efforts into money to pay the stockholders and finance other development programs.

Each step in itself is relatively simple and straightforward. Completion of one phase demonstrates the commercial feasibility of progressing to the next and yields the background of information required to proceed. Work to be done in each step can be scheduled and a required completion date established.

Each process has unique features which bear on the method of organizing the work. For specific cases, steps might be eliminated or several might be carried on simultaneously. There may be good reason to build the commercial plant and the pilot unit at the same time. In this way initial large scale production is attained rapidly. The pilot work can be continued so that within a reasonable time the process will be refined and the main plant can be modified to operate at high efficiency.

Timing

Next, consider the timing of each development step. The most important point to be considered in laboratory research is to obtain the information needed as quickly as possible and waste no time on data that is not absolutely necessary. It should not be a general literature and experimental study, but a concentrated drive toward a specific goal. If we can obtain all the information that we need for the next development step in one week rather than six months, we should certainly stop when we are finished and go ahead with the next phase.

Evaluation of the product or determination of the potential market must be done carefully and with judgment. This is not a good place to try to save time by taking short-cuts. There must be a market and the product must be acceptable or the entire program is on false ground. If it can be established that a sizeable market exists, it is safe to start on the next step and let the specific figures on the volume of the market come along concurrently.

In process study, equipment types must be selected for each operation and preliminary data obtained for roughly sizing the apparatus. This phase can often be done quickly, if necessary, by putting a large number of engineers to work, each on a separate operation or part of the process.

In the next step, preliminary engineering, the best possible design of a commercial plant is made, based on the information at hand. By doing this work, the necessary quantitative information required from a pilot plant can be determined.

A complete flowsheet of the process should be prepared, showing the equipment, valves, piping, traps, vents, sampling connections, instruments, and controls. Nothing necessary to the operation of the plant should be omitted since the flowsheet will serve as a sort of check list to avoid forgetting anything as the job progresses. The flowsheet may be altered as the pilot plant work is completed; this is to be expected.

Cost Estimate

Estimation of the probable cost of the plant is necessary so the management can decide whether it is worthwhile to develop the process further and construct the commercial unit. A good way to do this on a preliminary basis is to approximately size the equipment, estimate or obtain quotations on the individual items, and add up a total equipment cost. Multiply this by a factor which, by past experience, gives the final total cost of the plant, including piping, valves, instruments, insulation, erection, buildings, preparation of the site, roads, offices, laboratories, and so forth. (See *Chem. Eng.*, Oct. 1947, pp. 117-121, for such estimating factors.)

It is frequently necessary to make some very arbitrary decisions in order to proceed. For example, suppose management decides the plant should be located in the most suitable place in the whole United States. Certain areas can immediately be eliminated as being unsuitable, but a wide choice is still left. After a reasonable amount of study a decision on the location must be made so that other phases of the work can proceed.

Preliminary engineering can, if desired, be split up into a large number of parts so that many engineers can work on this step at the same time.

It is often said that pilot plant operations take too much time. This is frequently true, but it does not need to be so. A properly organized development program, employing skilled personnel and up-to-date equipment, can be executed rapidly if required. A systematic method of handling these problems will speed up the work by eliminating false moves and making each step count for the utmost.

It is usually difficult to decide on the proper size or capacity of the pilot unit. It should be large enough to use equipment which can be readily constructed and it should produce enough product to give large samples which can be tested commercially. It should not be so large that the cost of raw materials for experimental runs is excessive, nor should it be so large that its cost is great compared with the final commercial plant. It should be remembered that the smaller the unit, the faster a program of investigation can be carried out.

Pilot Plant Data

Good judgment must be used in deciding where to concentrate efforts and where no investigation is needed. The results should be worth the cost and time of obtaining them. It would be folly, for example, to spend $1,000 and a month's time securing complete heat transfer data on an operation where only a small amount of heat is involved, control is not critical, and the heat exchanger in the commercial plant will cost only $200. The desire to do a good job of investigation should be tempered by a sense of values.

There is no point in obtaining certain types of information in pilot plant work when data based on commercial operations are available and more accurate. Heat transfer coefficients with low viscosity, non-scaling, non-corrosive liquids; agitator speeds and horsepowers when handling thin liquids and where the degree of agitation is not critical; and pressure drops through equipment or piping except

under peculiar conditions do not require pilot plant study. An engineer, well versed in equipment design, has excellent information on these points based on commercial operations. Definite points for pilot investigation include yields, effect of raw material impurities, corrosion resistance, sludge accumulation, and construction of mechanical apparatus such as pumps and stuffing boxes for hard-to-handle materials.

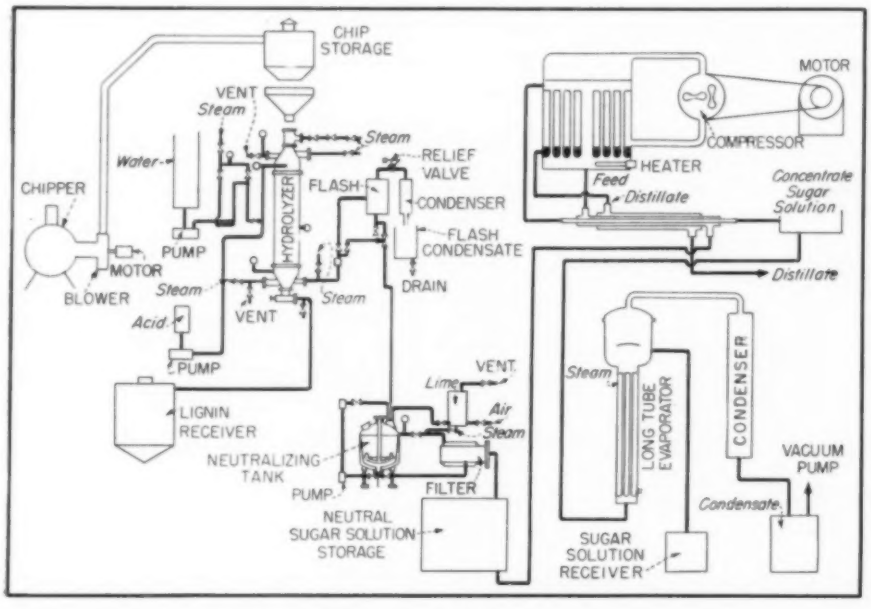
During the course of the pilot plant work, meetings should be held at least once a week so that the engineers assigned to the job can discuss the progress and future plans with the department head, specialists who are working in a consulting capacity, a representative of the research department, and a member of the engineering department. Progress can be checked against the time schedule so that no part of the work will lag. It is frequently very difficult to come to definite conclusions on certain points in development committee meetings because of the difference in views expressed. Such a conference can develop into a sort of debating society. It is of considerable help to have these meetings run by someone who can assist the group in making up their minds, or if there is no agreement, make up their minds for them.

A complete detailed record should be kept of all the pilot plant work, including drawings, curves, tables of data, descriptions of runs, photographs of the installation, and conference notes since the design and construction of the commercial plant will probably be done by other personnel. Results of many months work and thousands of dollars expenditure must not be transmitted by word of mouth.

Dates set up for the completion of the various phases of a development program should be realistic. Ridiculous dates should not be set up with the idea of creating a challenge or driving the staff to do something that is impossible. Everyone likes a challenge but does not wish to be confronted with an impossible situation.

When time is important, engineers and engineering departments should be conservative only in matters dealing with public safety. Decisions should not arbitrarily be made on the conservative side if additional expenditures of time are involved.

The most important thing about timing is that the development man should constantly be conscious of it and let it influence his decisions.



Process used by Forest Products Laboratory to produce . . .

Molasses From Wood Waste

PRODUCTION of molasses from wood wastes has been studied on pilot plant scale by the Department of Agriculture and the details of the process have recently been announced.* Briefly the process consists of pressure hydrolysis of wood chips, using dilute sulphuric acid at high temperatures. The resultant dilute sugar solution is then neutralized and concentrated by evaporation. Molasses thus obtained has a somewhat bitter taste but is suitable as a substitute for blackstrap molasses for stock feed and for industrial purposes.

In the process, wood is first chopped to ¼ to 1-¼ in. size and packed into the hydrolyzer to a density of 12 lb. per cu. ft. Air is removed and steam passed in until the pressure is built up to 50 psig. Dilute sulphuric acid feed is then started. Strength of the acid is 0.5 percent and temperature is held at 150 deg. C. Rate of acid feed is 1/20 of the dry weight of the wood per minute. After about 1¾ hr. the temperature is raised to 187 deg. C. After the hydrolyzer is full, sugar solution is withdrawn at a rate equal to addition of fresh acid. The entire cycle takes three hours. Lignin remaining in the hydrolyzer is removed and a new cycle can then begin.

The dilute sugar solution leaving the hydrolyzer passes first to a flash chamber where pressure is reduced to atmospheric and as much steam as possible is removed. The solution now is collected in a neutralizing tank and lime is added until the pH is 3.7. The solution at this point will average 4.5 to 6.0 percent sugar. From the neutralizing tank the solution is pumped through a Kleinschmidt recompression evaporator and finally to a one-stage vertical tube vacuum evaporator. The product is 50 per cent molasses.

By variations of the process, it is possible to recover two byproducts. Furfural is produced in small quantities from pentose sugars present in the hydrolysis product. The amount will vary from 10 to 30 lb. per ton of wood. Methoxyl groups present in the wood carbohydrates are converted to methanol, which passes off in the vapors. From 10 to 20 lb. per ton of wood is produced.

The molasses yield from wood is 150 to 190 gal. of 50 percent strength per ton of wood used, varying with the type and form charged.

Cost estimates have been drawn up for a plant to produce 50 tons per day of molasses. Dependent on the source, wood cost is estimated to vary from $2.20 to $6.60 per ton of molasses. With this raw material variation, the total operating cost is estimated at $13.20 to $17.60 per ton. This cost includes depreciation but no profit or return on the investment.

* Abstracted from Report No. R1704, "Wood-Sugar Molasses from Wood Waste," by E. E. Harris, Forest Products Laboratory, United States Department of Agriculture, December 1947.

Big Inch Pipeline
Little Big Inch Pipeline
LEGEND
Major pipelines
Pipelines authorized or under construction
Connecting line of United Gas Pipe Line Co.
Compressor stations, centrifugal
Compressor stations, reciprocating
Pump station sites
Gas field — gas supplied under contract and connected or to be connected
General area of present and potential gas supply
Delivery points
Scale in Miles
0 100 200 300 400 500
FIG. 1

BIG INCH and LITTLE BIG INCH pipelines moved oil to the Eastern Seaboard in wartime. Now they carry natural gas over the same route. WAA sold them as war surplus but terms of sale provide for recapture in time of emergency.

Natural Gas Goes North

Use of centrifugal compressors helped Texas Eastern convert the Big Inch and Little Big Inch pipelines from petroleum carriers to gas transmission lines.

B. D. Goodrich
Chief Engineer
Texas Eastern Transmission Corp.
Shreveport, La.

Big Inch and Little Big Inch pipe lines were constructed by the government during the war to carry petroleum and petroleum products from the Gulf Coast to the Eastern Seaboard. Their operation was discontinued in the fall of 1945 after V-J Day. In April 1946 they were declared surplus under the Surplus Property Act of 1944 and the War Assets Administration advertised for bids for their disposal. The Texas Eastern Transmission Corp. was the successful bidder and the company took possession of the property on May 1, 1947 under a Letter of Intent to complete purchase of the lines by November 25, 1947. The firm indicated in its proposal that it intended to operate these lines for the transmission of natural gas.

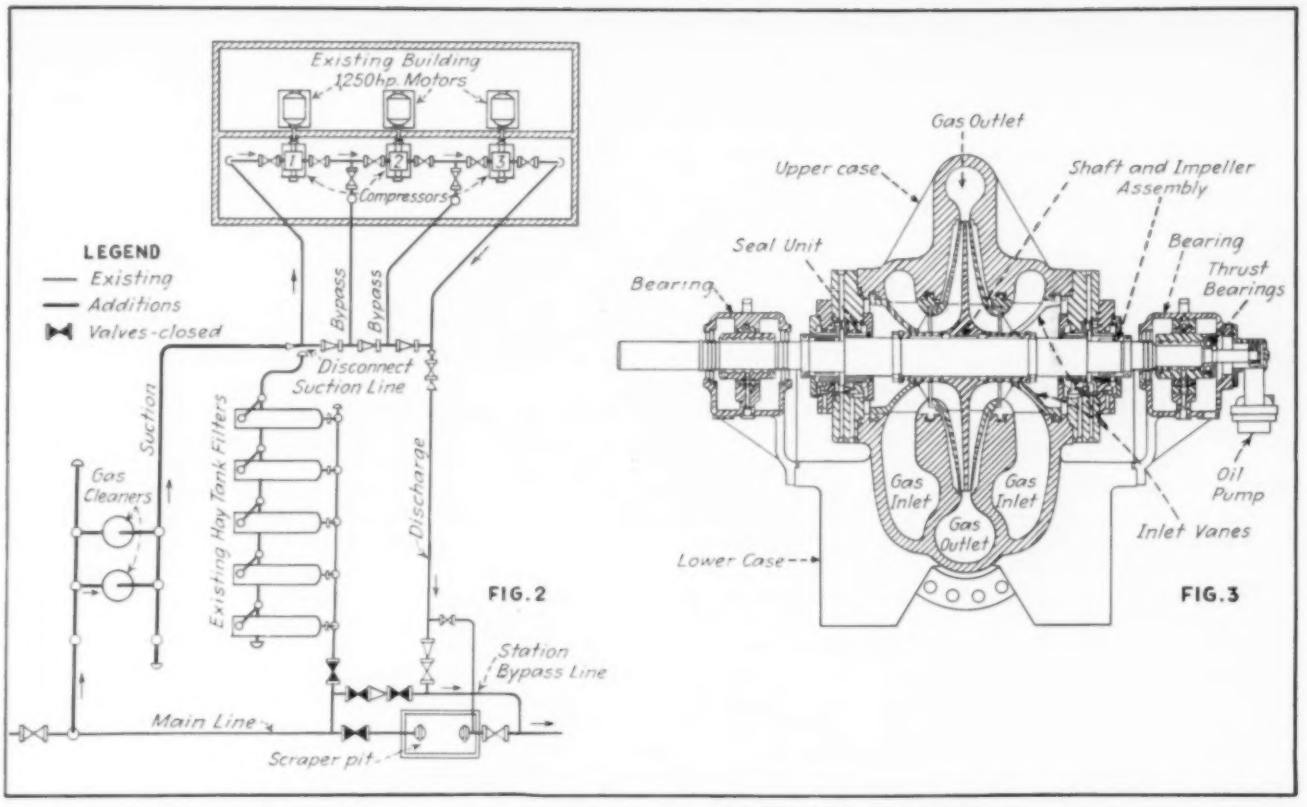
Conversion of these lines presented one of the most unusual problems in the long distance transmission of gas. Here, we were faced with a line already in place with a definite origin and a definite termination. There was no choice of an area for gas supply and no choice of an area for the market. It was necessary to develop those which existed along or adjacent to these lines. Further, the sizes of the lines were fixed, as was the wall thickness of the pipe, which in turn determined the pressures at which they could be operated. The locations of the pump stations were established.

The government included in the terms of the sale of the property the National Security Provisions providing for its recapture in time of emergency. The company must be able to restore the property within 90 days to the same operating conditions, ordinary wear and tear excepted, that existed at the time of the sale.

A map (Fig. 1) of the Texas Eastern Transmission Corp. system as we propose to operate these properties is shown. At the present time, the company intends to utilize all of the 24-in. line from Longview, Tex., to the Philadelphia area and all of the Little Inch line from Beaumont, Tex., to the Philadelphia area for the transportation of natural gas. From the Philadelphia area to Linden, N. J., there are two 20-in. lines. They are used at the present time for storage.

As a result of the decline of the natural gas fields which serve the Appalachian area and the increased growth and demand for natural gas in this region, the Appalachian area presented an attractive market. Major gas

Presented in New Orleans, La., at the spring meeting of ASME, March 1948.



OIL PUMP STATIONS became gas pump stations after centrifugal compressors replaced pumps at 1, 2, and 3.

CENTRIFUGAL COMPRESSORS contain only a fraction of number of separate parts in equivalent reciprocating pump.

distribution companies operating in this territory were anxious to augment their gas supply since their requirements were so great and the supply so short that a very critical condition existed. The metropolitan Philadelphia area has also had a tremendous growth and a resulting demand for fuel gas. Successful negotiations have resulted in plans for the delivery of natural gas to this area by July 1948.

For our gas supply, it was necessary to obtain reserves as close as possible to the lines, since pipe was and still is difficult to obtain. We were fortunate that the location of the 24-in. line lay close to several fields in northeastern Texas which did not have an outlet for their gas and also within 45 miles of the great Carthage Field in Panola County, Tex. From this area, we were able to obtain a sufficient quantity of gas to load the 24-in. line to capacity. The Little Inch line running North and South most of the way through the western portion of Louisiana, passes within a short distance of several major fields, some of which did not have gas outlets. The feeder system for the Little Inch line running from Beaumont West to the Houston, Texas City area, also was adjacent to many small fields.

Big Inch main line runs from Longview, Tex., to Linden, N. J., a distance of 1,340 miles. The Little Big Inch originates near Beaumont, Tex., and terminates at Linden, N. J., a distance of 1,479 miles. The 24-in. line has $\frac{3}{8}$-in. walls. The pipe is seamless. The 20-in. line is primarily composed of pipe with a $\frac{7}{16}$-in. wall and is essentially all electric weld pipe. The allowable safe design working pressure for natural gas for both lines is 790 psig. Some difficulty was experienced by the WEP in obtaining this pressure when testing the 20-in. line and the maximum test pressure was then limited to 750 psig. We decided to operate the lines from Little Rock, north as a looped system, thus establishing the working of the 20-in. line as that for the whole system. We were further restricted as to maximum working pressure by the fittings and valves originally installed which were all 800 psig. and the majority were of cast iron.

Problems Considered

With the operating pressure established, studies were begun to determine the quantity of gas that could economically be transported through the lines. All of the original studies were based on the use of gas engine driven compressors and a station spacing irrespective of the existing pump station sites. These studies determined that the best operation should be with a daily delivery of 420,000-450,000 mcf.

At about this time (April 1947), inquiries were made of the engine manufacturers to determine if we could obtain engines and their approximate delivery dates. Out of these discussions came a proposal to build a centrifugal compressor using an electric drive. This was very interesting, and immediately appealed to us because of the increased possibilities it presented to better utilize the facilities that were being purchased. The management asked for an immediate investigation into the practicability of the use of the centrifugal compressors. All of the available published information was assembled and studied. Discussions were held with the equipment manufacturers and from these investigations, it was developed that: (1) Centrifugal compressors had not been used for pressures above 500 psig. (2) They had not been used for long gas transmission lines. (3) There was some question as to the ability to obtain a satisfactory seal for this service and these pressures. (4) Considerable progress had been made in their design during the war, both in the techniques of their manufacture and the materials that go into their construction. (5) First cost of the compressor and motor was in line with other compressing equipment. (6) Maintenance and op-

erating cost other than fuel were estimated to be considerable less than for gas engines. (7) The centrifugal compressor is essentially a high capacity machine.

Management was advised of the known limitations of this equipment, none of which appeared incapable of solution. Economic studies further developed that by using the centrifugals more gas could actually be delivered to the market, since no gas for fuel would be required, and the price we could afford to pay for the electric power was in the range of that which the WEP had paid, during the operation of the line for oil service.

Break with Tradition

The hardest part of the decision to use centrifugal compressors was the break with tradition. As always, we would rather someone else would try it first. But management had the courage, whether by wisdom or necessity, to break away from tradition and trust the engineers, designers and manufacturers to produce the equipment that would perhaps revolutionize the transportation of natural gas. This decision was made in April 1947.

One of the first decisions made was to design the compressors to fit the foundations and piping in the pump houses on the former 24-in. crude line and 20-in. products line. In other words, we proposed to take the oil pump out of service and replace it with a compressor for gas service. This arrangement established the physical design of the compressors calling for a double suction unit, very similar in appearance to the liquid pumps that they were to replace. A second major decision was to establish the speed of the compressors at 3,600 rpm. This meant that we could utilize all of the electric motors from the Products Line as direct connected prime movers for the compressors. They are 1,250 hp. —3,600 rpm.—2,300 v. squirrel cage induction motors. The motors from the crude line could not be so easily adapted since their rated speed is 1,750 rpm. and thus would require a speed increasing gear. At the present time these motors are not being utilized.

With the physical appearance and speed of the machine established, the next step was the size or capacity. This was limited by the horsepower of the existing motors which we proposed to utilize.

Our flow studies using reciprocating engines had developed that a compression ratio of approximately 1.3 would exist with spacing of the stations approximately 50 miles apart and passing approximately 425,000 mcf. per day at 15.025 lb. pressure base. With this ratio in mind, it was further determined that it could be developed by using three stages of compression, with the centrifugal equipment. The design capacity of the compressors was then established as 225,000 mcf. through a compression ratio of 1.3 in three stages. Other design conditions were inlet temperatures of 60 deg. F., specific gravity of 0.60 and discharge pressure of 750 psig. and an "N" or "K" value for the gas of 1.27.

By operating the crude and products pump stations in parallel, the capacity of the six single stage centrifugal compressors is approximately 450,000 mcf. per day at design conditions.

The manufacturers began their work on the detail design of the machines in May 1947. Texas Eastern began operations of the line under a lease arrangement with the War Assets Administration on May 1, 1947. Natural gas was introduced into the lines at 750 to 800 psig. and without compression delivered approximately 140,000 mcf. daily to the Appalachian Area.

The capacity of the system was established at approximately 450,000 mcf. daily, representing 433,000 mcf. actual sales and the remainder for fuel, loss and unaccounted gas. The centrifugal compressor, electrically driven as proposed, lacked one very important feature and that was variable capacity, speed or compression ratio. These were all fixed. The only means of changing the operation was by shutting down one stage or by throttling with the suction valves, neither of which is very desirable. To offset this lack of ability to meet changing flow conditions, several reciprocating stations were included in the final design of the system, spaced strategically to best make the system as a whole capable of meeting varying conditions of flow. A total of 36,000 hp. will be installed in five of these reciprocating stations. Some of these stations have standby engines and all of the compressor cylinders have variable clearance to better adapt them to a wide range of flow and pressure conditions. The system is designed to maintain as close as possible a 750 psig. discharge from all stations.

The design of the centrifugal stations was initiated with the primary aim of utilizing as much as possible of the existing building, piping and equipment as could conveniently and economically be included in the operation of the station for gas service. The chart (Fig. 2) will indicate to what extent this was possible. In fact, about the only things that are not utilized are the oil pumps. The chart indicates also that the strainers on the former products stations are not being used, instead we have installed conventional gas scrubbers of the liquid type as a protection for the compression equipment. The only major piping not being utilized is the former inlet from the main line to the pumps. A new suction line has been installed to the inlet of the first compressor. All other major piping, including manifolds around the pumps and discharge back into the main line, is being used essentially as for oil service and with the addition of no valves or check valves except on the new suction line and at the scrubbers. Most of the miscellaneous small piping and tanks have been put to some new service. The former sump or drain tanks are now used as storage reservoirs for the oil used in the scrubbers, or as a blow down or drain from the scrubber. The former slop tank on the products line is being utilized as water storage for the cooling system.

Electrical System

The electrical system, one of the major facilities at each station, is being utilized completely and in a very similar manner as for oil service. The existence of these electrical facilities was a very important factor in the decision to use the centrifugal compressors with electrical drive. Other buildings at the stations are being used for storage or office use in much the same manner as the War Emergency Pipelines, Inc., used them. Very few new structures will be built except a new warehouse for storing the oil pumps and motors from the oil lines. The new warehouse will give complete protection for this equipment, thus assuring the best possible maintenance for it.

Because of the National Security Provisions in the purchase agreement, which require "that the property shall be restored to use as an oil carrier within 90 days," it was advisable to make as few changes as possible in the piping and electrical facilities. We think we have been successful in this. Most of the changes which have made or will be made with the property consist of the transfer of motors, switch gear, transformers, and large valves from stations not being used for gas transmission to those stations which we propose to convert.

At those stations where reciprocating equipment is being installed, no changes are being made that will ef-

fect the use of the former oil stations for reuse in that service. Here, completely new buildings and equipment are being installed. The idle pump stations will remain in the state of protective maintenance to which they were so effectively and excellently retired by the War Emergency Pipelines, Inc., during the latter part of 1945. The maintenance program initiated at that time will be continued for all of this equipment.

Major additions proposed for the system other than the stations, contemplate the looping of river crossings as insurance against losing any of them, and the installation of main line gate valves throughout the system. Due to shortage in materials existing at the time these lines were constructed, few valves were installed between stations and it is considered to be good practice on gas transmission lines to have a valve every 12 to 17 miles.

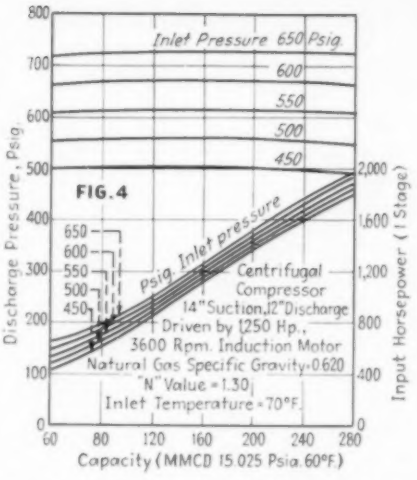
Both lines were received in very good condition and extensive cleaning, purging and repairs have not yet been necessary.

Two stations using the centrifugal compressors were placed in operation during the month of November 1947 and their performance has been substantially as predicted up to the present time. Extensive field tests of the first units were conducted at the Little Rock station during the month of October. These tests indicated that the manufacturers had done an excellent job on the compressor unit itself, although some changes were dictated both in the compressor and in the auxiliary equipment. These improvements and changes have been made and six stations are now in continuous operation.

Delivery Rate

Less than one year after taking possession of the property, Texas Eastern is delivering more than 300,000 mcf. (March 1948) of natural gas daily to areas where very critical fuel shortages exist. Only by the use of centrifugal compressors, could this have been accomplished. Construction is continuing on additional installations that will further increase the daily capacity to 433,000 mcf. by October of this year. A total of 16 stations utilizing centrifugal compressors and requiring an installed horsepower of 117,500 will be constructed.

On February 16, 1948, an application was filed with the Federal Power Commission asking for authority to further increase the capacity of the system to 508,000 mcf. of sales per day. This will be accomplished by adding additional compressors at both reciprocating and centrifugal stations throughout the system and will not require any looping or new stations.



Graph Shows Compressor Characteristics

The electrical industry has watched this development very carefully and have been most helpful to us in making the progress which has been achieved. Power shortages prevailed in many areas during the fall and winter of 1947 and will continue throughout this year. Through interconnections of various systems, the power companies are able to provide the power required for this operation even though many of these companies have already sold the capacity which had been used for the operation of these stations during the war.

The centrifugal compressor as installed in our stations is itself a very simple machine in appearance and contains only a fraction of the number of separate parts which are contained in a reciprocating machine of equivalent capacity. The major parts are indicated on the cross section of the machine (Fig. 3). The shaft sealing units are the most important. All of the others have been used in essentially the same form, either in liquid pumps or low pressure air or gas compressors for some time.

The seal is the heart of the compressor. Without becoming too technical, it is sufficient to say that in our machines it is a mechanical seal of the hydraulic type consisting of three primary parts, rotating ring and two stationary sleeves which provide the surface contact for the rotating ring. Oil at a pressure higher than that of the gas being compressed maintains these sleeves in proper contact with the ring and any oil leaking across these faces is fully recoverable. The oil also provides a cooling medium for the seals. Each compressor has its own seal oil system with standby units and protective devices in case of failures of any kind to either the oil system, electrical system or the compressor unit.

Operation of the compressors is very simple. Push button operation exists. In starting a unit a push button opens the discharge valve, a second button starts the motor. When up to speed, a third button opens the suction valve to load the machine. Other buttons are used to start the oil pumps on the bearing and seal oil system. All of these controls are mounted on a central panel so located that all of the machinery is in view of the operator.

Maintenance of a unit is expected to be very small. There is nothing much to wear or get out of order. A complete overhaul, that is dismantling the compressor completely, and replacing with all new wearing parts can be done in less than eight hours.

The compressor lends itself to prime movers other than the electric motor, particularly the steam turbine and, perhaps in the not too distant future, the gas turbine.

Single Stage Machine Curves

Characteristic curves for a single stage machine as developed from field tests are indicated in Fig. 4. The discharge pressure is very constant over a wide range of capacities for a given suction pressure. Power requirements are a function of suction pressure and capacity and as indicated by the slope of the curve is a fairly constant relationship. This test performance includes plug valves on the inlet and outlet of the compressor. We have not yet been able to isolate the performance of the machine itself.

Our units have been operated in every possible combination from two units in parallel to six units in series. No serious difficulties have been experienced. However, we won't say we haven't had our share of troubles. Their operation in parallel is very sensitive at low capacities. In building up the capacity of the lines, it has been necessary to operate the centrifugal compressors for a time at less than 50 percent of design capacity. But good performance has also been experienced with one of our stations, operating during the month of January and February at better than 90 percent electric load factor.

There will undoubtedly be further changes and modifications in the equipment as continued operation reveals its characteristics and weakness but much progress has been made.

HOT: Insulated rosin scale tank operates at 340 deg. F.

COLD: Liquid butane is stored at moderate 40-50 deg. F.

Four Case Studies in the INSULATION OF TANKS

Unusual problems in insulating tanks sometimes present a stumbling block to thermal efficiency. This article shows the ingenious ways several tricky tanks were handled.

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Harry W. Smith, Inc., New York, N. Y.

RECENT case histories from the files of the Industrial Mineral Wool Institute show a wide and varied usage of this insulating material in insulating both heated and refrigerated tanks in numerous branches of industry.

Cases Show Techniques

Several cases discussed here were selected for the different insulation techniques they illustrate and for the economics that resulted, as well as for their novelty, and for the variety of industries they represent. All cases contain valuable information which will be useful whenever tanks are to be used for storing high- or low-temperature gases or liquids, regardless of the size or shape of the tank.

Case (1)—An interesting tank insulation case involving a scale-mounted, 340-deg. F., steam-heated rosin tank of 25,000 gal. capacity illustrates a technique used in installing mineral wool blocks. In this installation, the insulation was 94 percent effective in preventing heat loss.

Located at the Newark, N. J., plant of U. S. Industrial Chemicals, Inc., this tank measures 14 ft. in diameter by 18 ft. high. It weighs 200,000 lb. when full. The outdoor scale it is mounted on is adjusted to compensate for the weight of the tank and its underpinning. As rosin is drawn off for process work, the scale beam automatically shuts off the pump at the correct point.

Steam coils, mounted about a foot above the bottom of the tank and extending across the inside of the tank, keep the rosin at 340 deg. F. so it will remain fluid and can be piped to processing locations.

The vertical tank is insulated with mineral wool blocks, 3 in. thick, measuring 18 by 36 in. The blocks are held in place by wire bands drawn tight and crimped. They mount one above another, in staggered rows, up to and across the top of the tank. A 1-in. hexagon wire mesh is secured in place over the blocks, and forms a key for the finishing coat. The latter is composed of a mixture of heat-resistant cement and portland cement, troweled on to a thickness of ½ in. Over this is troweled a ¼-in. coat of fibrated emulsified asphalt, giving the entire tank a smooth, neat, and weatherproof finish.

Stainless-steel, steam-jacketed rosin pipes lead to the tank and are insulated with 2-in. thick mineral wool pipe covering of the molded type. The pipe covering is incased in a roofing-felt jacket, overlapped 2-in. at both longitudinal and circumferential seams. Jacket and insulation are held in place by 16-gage wire, tied around the pipe at about 6-in. intervals. Pipe-bend insulation is coated with fibrated emulsified asphalt, troweled on. This and the felt jacket amply protect the insulation from moisture.

The bare surface of the tank, 1,100 sq.ft. in area, would waste 825,000 Btu. per hr. without insulation. The insulation covering cuts more than 94 percent of this loss, the saving being equivalent to about a ton of coal every 24-hr. day.

Case (2)—This case, a horizontal asphalt tank situated in Flushing, N. Y., is noteworthy because electricity is used in heating the tank. Since the cost of this "fuel" is notably high, it is doubly important that heat losses be kept at an absolute minimum.

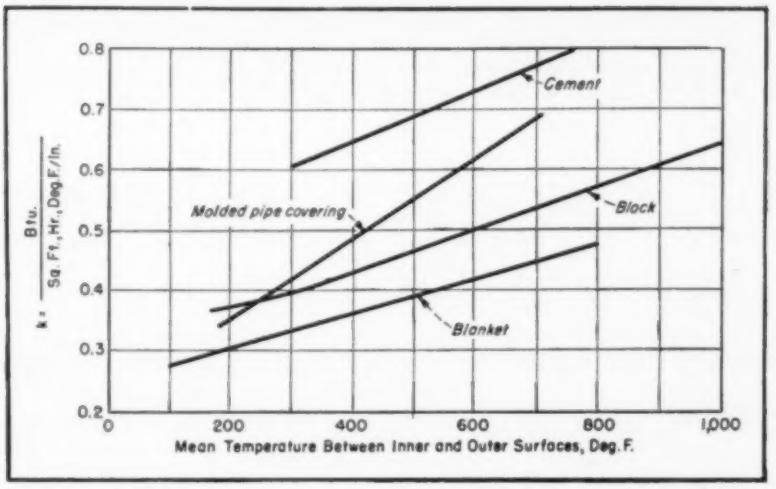
Use of Air Space

Provision of an air space between the tank exterior and the insulation is an unusual feature of this installation. The insulation consists of 4-in. thick mineral wool blankets sandwiched between expanded-metal lath. Narrow clips of light-gage metal were spot-welded to the tank surface on 8-in. centers so that 8-in. clip-legs stuck out from the tank. The blankets were impaled on the clip-legs to within 2 in. of the tank, thus forming the air space.

After the blankets were pressed into place, the protruding 2-in. clip-leg projections were bent over to hold each section in place. A ¾-in. coat of mineral wool insulating cement, troweled into the lath which acts as a key, forms the base for a weather-sealing asphalt coating ½ in. thick. After the insulating cement had dried through, it was covered with 1-in. poultry netting over which an asphalt seal was applied.

Normally, 2-in. of mineral wool would be recommended for a surface operating at 300-350 deg. F., but with the high-cost energy used for heating, extra thickness is amply justified.

Considerable interest attaches to the method of heating the tank. The under side contains heating coils rated at 45 kw. Heat generated moves over the entire surface of the tank through the air space, which explains the need for the unusual arrangement described. A small heater (2.4 kw.) on the delivery pipe keeps the asphalt in the line sufficiently fluid to avoid plugging.



WHAT LOSS? Chart shows *k*-values for four forms of mineral wool insulation at mean insulation temperatures to 1,000 deg. F.

Case (3)—The most universally insulated tank is the steam boiler. It is used in virtually every industry, and varies in size from the modest units used in room heating, to the multi-story units providing steam and power for mile-long industrial plants.

Techniques used in insulating this classification of equipment are pretty well known; however, there is still a lack of know-how when it comes to the insulation of boiler headers, manifolds, and pipe flanges.

Mineral Wool Cement

For these jobs, mineral wool cement supplements the block or blanket form used on uninterrupted tank surfaces.

For example, the Key Co. of East St. Louis, Ill., recommends the use of mineral wool cement in insulating boiler headers in which the handhole covers made by this concern are used.

The cement can be smoothed over the flange projection of each handhole cap and built up to whatever thickness is specified for the given boiler temperature. When access to any cover or group of covers is necessary, it is easy to break away nearby insulation, and reapply the cement after the cap is replaced. In normal instances the relatively long fibers of mineral wool make it possible to reuse the original cement.

Case (4)—Mineral wool insulation proved to be the solution to a large-volume butane storage-tank problem at the Marcus Hook, Pa., refinery of the Sun Oil Co.

The problem was to insulate seven spheroidal butane storage tanks so that 280,000 bbl. of liquid butane could be stored at 45-50 deg. F. and 20-25 psi. without the use of heavy steel tanks or excessively large refrigerating units. To store the butane at atmospheric pressure would require cooling to below 32 deg. F., and would call for an excessive quantity of insulation and refrigeration equipment. To store without any cooling would require pressure vessels capable of handling up to 90 psi. internal pressure, and would necessitate costly steel construction.

In solving the problem, the point of greatest economy was determined to be storage at 45-50 deg. F. under 20-25 psi. pressure, with 1 in. of mineral wool board, or block, insulation. The insulating material was selected both for its high insulating efficiency and its ease of installation. Standard-sized boards were stuck to the metal surface with hot asphalt. Galvanized wires, welded to the steel tank and projecting through the insulation, were attached to poultry netting applied to the outside surface of the boards. The finished job was weatherproofed with a troweled-on asphalt mastic coating.

Size of Job

The second of the two views on the preceding page suggests the magnitude of the job, each of the seven tanks being 85 ft. in diameter at its equator and 65 ft. high. The insulation boards were sufficiently pliable to fit the slight curvature of the tank surface.

Complete installation details for all forms of mineral wool for various types of applications can be found in two U. S. Bureau of Standards bulletins: (1) Bulletin CS-117-44, "Mineral Wool: Blankets, Blocks, Insulating Cement, and Pipe Insulation for Heated Industrial Equipment"; and (2) Bulletin CS-105-43, "Mineral Wool: Loose, Granulated, or Felted Form, in Low-Temperature Installations." Both are available free of charge in limited quantities, from the Industrial Mineral Wool Institute, 441 Lexington Ave., New York City.—Editor.

Simplified Approach to Preliminary COST ESTIMATES

Knowing only delivered cost of equipment to be used, a good approximation of overall plant cost can quickly be reached with the factors presented in this article.

In a Nutshell:

$$\text{Delivered Equipment Cost} \times \begin{cases} 3.10 \text{ for solid process plants} \\ 3.63 \text{ for solid-fluid plants} \\ 4.74 \text{ for fluid process plants} \end{cases} = \text{Total Estimated Plant Cost}$$

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Engineer, Day & Zimmermann, Inc.
Philadelphia, Pa.

PROCESS EQUIPMENT COSTS

Two EARLIER articles (*Chem. Eng.*, Sept. 1947, pp. 130-133 and Oct. 1947, pp. 117-121) discussed the preparation of preliminary estimates and indicated that it should be possible to develop a simplified method for obtaining a quick estimate of the approximate cost of a process plant. This simplified method is developed here. As in the previous articles, the viewpoint is that of an independent engineering and construction firm.

An estimate, whether preliminary or final, involves a considerable amount of work. In order to estimate the cost of a building it is necessary to know its size. This is true whether building costs are estimated on a cost per unit volume basis as in preliminary estimates, or on the basis of a detailed breakdown of the costs which enter into building construction, as in a final estimate. It is therefore necessary to prepare layout drawings or sketches to complete either type of estimate. Similar considerations apply to every item that enters into a preliminary or final estimate, whether it concerns the length of a utility line or the size of a substation.

The simplified method presented here is not intended to supplant the preparation of preliminary estimates but is intended only to give a judgment somewhat more reliable than an outright guess. The utility of this method can best be explained by an example.

A client was interested in adding equipment to his plant for the purpose of recovering fines from various stages in his process. Since he was fairly familiar with equipment prices, he estimated that the cost of the equipment delivered to the site would be approximately $60,000. This did not include foundations, supports, chutes, insulation or installation. However, he was not familiar with estimating costs for these items or with estimating costs of accessory facilities such as structures, buildings and electrical work.

A quick check on the estimate he had prepared for the cost of equipment indicated that $60,000 was a fair value. The simplified method discussed below indicated that the total cost of the recovery system including engineering, construction, contingency and all other factors entering into design and construction would be $186,000. A preliminary estimate prepared at a later date from a flowsheet and a preliminary layout indicated a cost of $190,000. In other words, there was substantially no difference between the simplified method and the preliminary estimate.

Actually, of course, the differences that can be expected by using the simplified method, as compared with the preparation of a preliminary estimate based on flowsheets and layout drawings, will not always work out as well as in the example cited above. In general, however, these differences will fall within 10 to 15 percent of the estimated cost given by a preliminary estimate.

The simplified method presented here is based on a study of 14 estimates for plants of various sizes and types presented in the two articles mentioned above. This study indicated that:

1. The total installed cost of process equipment and piping is very nearly independent of plant size and type.

2. The delivered cost of process equipment is about 70 percent of the installed cost. The installed cost includes foundations, supports, chutes, gates, vents, insulation and installation.

3. The ratio of process piping to process equipment costs varies within relatively narrow limits for each of the following types of plants, including (*a*) solid process plants; (*b*) solid-fluid process plants; and (*c*) fluid process plants.

A distillation unit would be classified as a typical fluid process plant, a coal briquetting plant as a typical solid processing plant and a solvent extraction plant complete with bean preparation and meal processing facilities as a typical solid-fluid processing plant.

For the simplified method, the costs

which make up design and construction have been divided into two groups, including: (*a*) construction costs; and (*b*) overhead costs.

Total construction cost consists of the material and labor costs for yard improvements, buildings, building services, process equipment and piping, electrical installations and service facilities including insurance and taxes on labor and premium time, if any.

Total overhead cost consists of contingency, field office expense including temporary construction, engineering expense and the engineer-contractor's fee.

The total construction cost as used here is identical with the sum of Items *A*, *B*, *C*, *D*, *E*, *F*, *H* and *I* in Table I of the first of the two articles mentioned above. The total overhead cost is the sum of Items *G*, *J* and *K* plus the fee.

Simplified Method

An outline of a simplified method for estimating the cost of process plants is given below:

1. Estimate the cost of process equipment delivered to the site. Call this *A*. This information is frequently easily assembled by letter and telephone or from cost records.

2. Multiply *A* by 1.43 to give the installed cost of equipment including foundations, supports, chutes, vents, insulation and installation. Call this quantity *B*.

3. Multiply *B* by the following factors depending upon type of process:

1.10 for solid processing
1.25 for solid-fluid processing
1.60 for fluid processing

This will give the installed cost of equipment and piping. Call this *C*.

4. Multiply *C* by 1.50 to get the total construction cost of the plant.

5. Multiply the total construction cost by the following percentages to obtain the total overhead cost:

31 percent for solid processing
35 percent for solid-fluid processing
38 percent for fluid processing

The sum of the total construction and the total overhead costs is the total estimated cost of the plant.

6. The factors and percentages given above do not include premium time since this item is now usually excluded from estimates. If premium time labor is to be used on the entire project, the total construction cost should be increased by 4 percent for a 48-hr. week. This percentage does not allow for any reduction in labor efficiency due to overtime work.

Four examples of the application of this method are given below. These examples have been selected at random from estimates prepared since the two articles mentioned above were published. The first two examples apply to new plants and the last two apply to existing plants.

Example (1) is a new solid-fluid processing plant for which the estimated cost of the equipment delivered to the site was $362,000.

The estimated installed cost of the equipment is therefore $362,000 times 1.43 or $520,000.

The estimated installed cost of process equipment plus piping is $520,000 times 1.25 or $650,000.

The total construction cost is $650,000 times 1.50 or $975,000.

The total overhead cost is $975,000 times 0.35 or $340,000.

The total estimated cost is then $975,000 plus $340,000 or $1,315,000.

The preliminary estimate indicated that the total cost of this project would be $1,210,000. This is a difference of $105,000 or approximately 8 percent.

Actually, if the factors given above had been qualified by the judgment of the estimator, a factor of 1.15 rather than 1.25 would have been used for estimating the total cost of process equipment and piping. In other words, even a preliminary survey of the project indicated that the piping work would not amount to $130,000 ($650,000 less $520,000). If a factor of 1.15 had been used, the total estimated cost by the simplified method would have been $1,220,000.

Example (2) is a new solid-fluid process plant for which the estimated cost of the process equipment delivered to the site was $1,400,000.

The estimated installed cost of process equipment is $1,400,000 times 1.43 or $2,000,000.

The estimated installed cost of process equipment plus piping is $2,000,000 times 1.25 or $2,500,000.

The total construction cost is $2,500,000 times 1.50 or $3,750,000. Premium time work was contemplated for this project. Therefore, the above figure should be increased by 4 percent to give a total construction cost of $3,900,000.

The total overhead cost is $3,900,000 times 0.35 or $1,370,000.

The total estimated cost of the project is therefore $3,900,000 plus $1,370,000 or $5,270,000.

A preliminary estimate prepared at a later date from preliminary layouts indicated a cost of $4,970,000. This is a difference of $300,000 or 6 percent.

Examples (3) and (4) are intended to show that the simplified method is also adaptable to plant additions.

Example (3) is the recovery system for fines mentioned above. This was entirely a solid handling process. The estimated cost of the equipment delivered to the site was $60,000. This total construction cost is, therefore, $60,000 times 1.43 times 1.10 times 1.50 or $142,000.

The overhead costs are 31 percent of the total construction cost. The total estimated cost of the recovery system by the simplified method is therefore $142,000 times 1.31 or $186,000.

Example (4) represents an addition to an existing solid-fluid process plant. The addition, however, was for handling solids only. A preliminary estimate prepared at a later date indicated that approximately $35,000 would have to be spent in altering existing equipment. This factor was entirely neglected in the simplified method. The estimated cost of new process equipment delivered to the site was $150,000. The total construction cost is $150,000 times 1.43 times 1.10 times 1.50 or $354,000. The cost of the plant addition is then $354,000 times 1.31 or $465,000. The preliminary estimate which was subsequently prepared from preliminary layouts indicated a total estimated cost of $545,000. This is a difference of $80,000 or approximately 17 percent.

Over-All Factor

The factors given above can obviously be combined into one factor to obtain the total estimated cost directly from the cost of process equipment. Combined estimating factors are given below for each type of plant:

Solid process plants	3.10
Solid-fluid process plants	3.63
Fluid process plants	4.74

These factors do not include premium time.

For Example (1), the combined estimating factor is 3.63 since this example applied to a solid-fluid plant. The total estimated cost is then the cost of the equipment ($362,000) times 3.63 or $1,315,000.

For Examples (3) and (4), the combined factor is 3.10.

In conclusion, it should be noted that the factors apply strictly to the size and type of plants discussed in the two articles previously mentioned. As pointed out in these articles, the conclusions reached were in many cases based on insufficient data. An experienced estimator who has been working on a relatively narrow variety of process plants should be able to develop factors similar to these but more adaptable to his purpose.

Three Steps To A Vinyl Monomer

Monovinyl derivative of dibenzofuran goes into dielectric material that pinch hits for mica. Process is one more war secret that now can be told.

EDWARD A. KERN and CHARLES W. WILSON

General Electric Co., Pittsfield, Mass.

War baby of General Electric research is a new dielectric material used in capacitors. Behind its manufacture is the story of how a three-step process for the production of 2-vinyldibenzofuran was worked out in the pilot plant. For polymerized 2-vinyldibenzofuran is the key constituent in the dielectric. Acetylation of dibenzofuran, reduction of the acetyl derivative to the carbinol and dehydration of the carbinol to yield the vinyl monomer are the steps. Closely controlled, the second and third steps are quantitative, eliminating troublesome separations.

ADVENT of World War II threatened a shortage of mica. Electrical manufacturers urgently needed a substitute dielectric material. Faced with this problem, chemists and chemical engineers at the Works Laboratory of the General Electric Co. in Pittsfield, Mass., turned their attention to polynuclear hydrocarbons. These possess heat stability, good dielectric characteristics and mechanical strength. They looked promising. Monovinyl derivatives of various polynuclear hydrocarbons were prepared and tested. Ease of handling of various intermediates and desirable properties of both the monomer and polymer of 2-vinyldibenzofuran were compelling factors in the final decision to produce this compound. A three-step process for pilot-plant production of 2-vinyldibenzofuran was developed. Poly-2-vinyldibenzofuran is a major constituent of Lectrofilm capacitors. As such, it was a wartime top secret.

Preliminary Problems

To synthesize polynuclear vinyl compounds was not an easy task. Among the problems which had to be solved were high boiling points, lack of polymerization inhibitor and slight differences in molecular weights. This last difficulty precluded use of the molecular still.

With these problems uppermost in their minds, GE engineers adopted a three-step process. It consists of (1) acetylation of dibenzofuran to 2-acetyldibenzofuran; (2) reduction of 2-acetyldibenzofuran to 2-dibenzofurylmethyl carbinol; and (3) dehydration of 2-dibenzofurylmethyl carbinol to 2-vinyldibenzofuran. This process has distinct advantages.

One great advantage is that the second step, under controlled conditions, is quantitative. This is desirable, since the separation of the ketone from the carbinol at this stage, although possible, is difficult. Reduction is continued until a negative ketone test is obtained, using 2,4-dinitrophenylhydrazine as test reagent. Under these carefully controlled conditions the amount of 2-ethyldibenzofuran produced is held to a minimum of 1 percent or less. Thus separation is unnecessary at this step.

Likewise advantageous is the fact that the third step can also be made to proceed quantitatively. This is essential in this process, since it eliminates purification, which is extremely difficult at this stage.

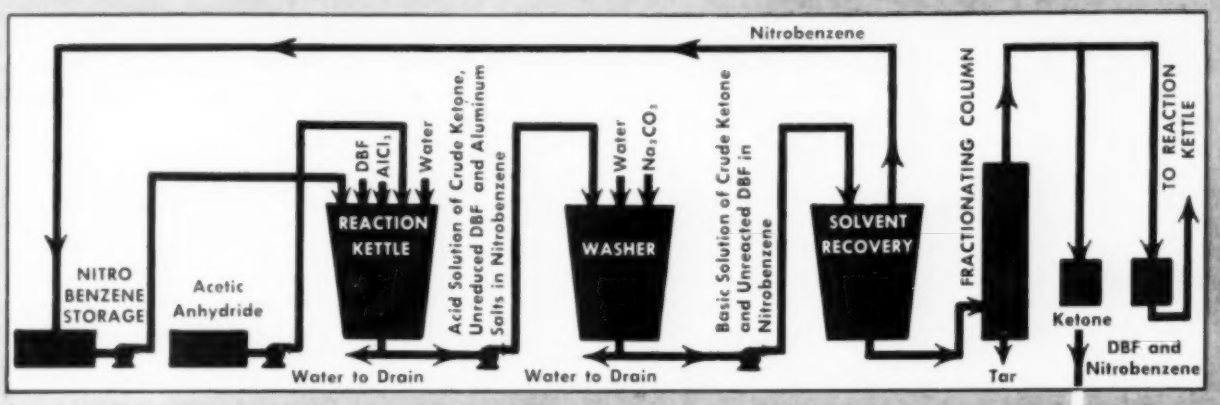
Step One

First step in pilot-plant production is the acetylation of the dibenzofuran by acetic anhydride in a nitrobenzene reaction medium. The reaction is catalyzed by anhydrous aluminum chloride. Whereas acetyl chloride is preferred in the laboratory, economics dictated choice of acetic anhydride as acetylating agent in large-scale production. Since it is a fire hazard, carbon bisulphide had to be replaced as the reaction medium. Carbon tetrachloride was tried. It gives poor yields when the acetylating agent is acetic anhydride. Tetrachlorethane, as well as many other chlorinated solvents, actually reacts under the conditions in the reaction chamber. None of these could be used. Nitrobenzene was finally chosen as the reaction medium. It is flammable, but its flash point is high enough to minimize the fire danger.

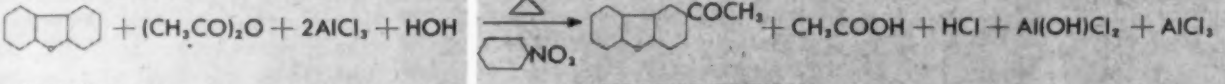
When nitrobenzene is used as the reaction medium, caution must be exercised. Dibenzofuran, aluminum chloride and the complex formed are all soluble in nitrobenzene. The complex formation is highly exothermic. Nitrobenzene itself can form a complex with aluminum chloride. This adds to the danger of the reaction running away if the temperature is not carefully controlled.

In pilot-plant operation, 50 gal. of nitrobenzene is pumped into the 100-gal. glass-lined reaction kettle. This Pfaudler kettle is equipped with an agitator, thermocouple well and scrub-

HERE ARE 3 STEPS...

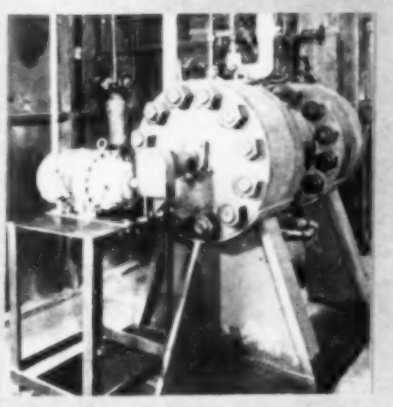


1. ACETYLATION

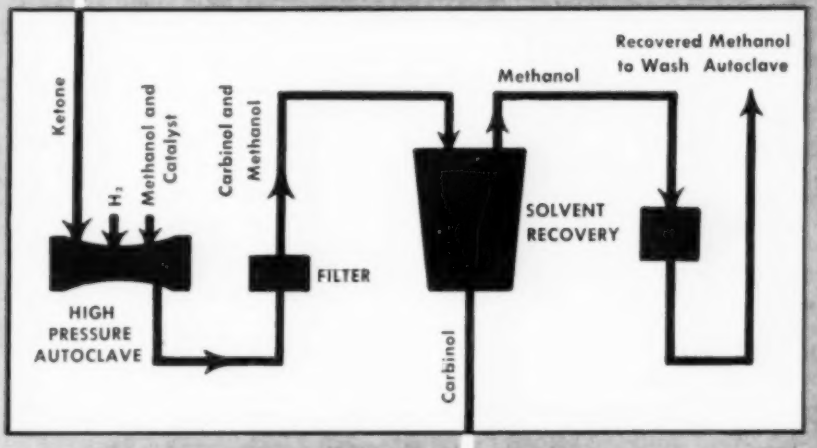


DIBENZOFURAN

2–ACETYLDIBENZOFURAN



High pressure horizontal autoclave



LEGEND

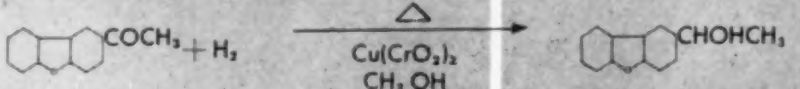
DBF — Dibenzofuran

Ketone — 2-acetyldibenzofuran

Carbinol — 2-dibenzofurylmethyl carbinol

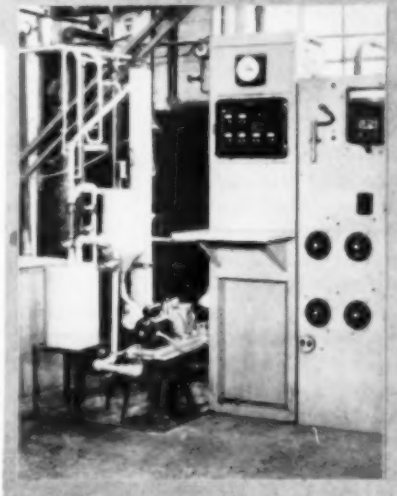
Monomer — 2-vinyldibenzofuran

2. REDUCTION

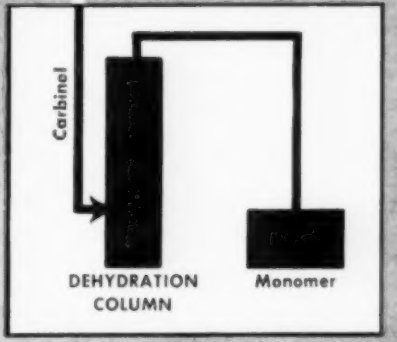


2–ACETYL DIBENZOFURAN

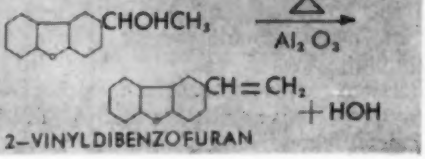
2–DIBENZOFURYLMETHYL CARBINOL



Dehydration column and controls



3. DEHYDRATION



2–VINYLDIBENZOFURAN

ber for removal of hydrochloric acid formed. It is jacketed so that it may be heated or cooled. Sixty pounds of dibenzofuran are then added and the mixture agitated until the dibenzofuran is completely dissolved. This process is endothermic. No special precautions are necessary at this point.

The kettle is then cooled with running water, and 100 lb. of anhydrous aluminum chloride is added at a controlled rate so that the temperature does not exceed 30 deg. C.

When all of the anhydrous aluminum chloride has been added and dissolved, 43 lb. of acetic anhydride is added through a metering pump at such a rate that the temperature does

not rise above 30 deg. C. When all of the acetic anhydride is in the kettle, the cooling water is shut off and the mixture is agitated for an additional two hours.

Aluminum complex formed during the reaction is hydrolyzed by pumping cold water into the kettle through a metering pump. The cooling water is also turned on.

When hydrolysis is complete, evolution of hydrogen chloride gas ceases. A large excess of water is then added, the entire batch stirred for 30 min. and finally allowed to settle. The organic layer is separated from the water layer and washed free from all traces of acid or salts. Nitrobenzene is removed from the organic layer under reduced pressure and the residue vacuum distilled.

Under these conditions, the reaction yields 85 percent of 2-acetyldibenzofuran, 8 percent of unreacted dibenzofuran and about 7 percent of tar, containing diacetyldibenzofuran.

Optimum yields are obtained when the mol proportions of dibenzofuran to aluminum chloride to acetic anhydride are 1 to 3.1 to 1.18.

Step Two

Second step in the process is the reduction of 2-acetyldibenzofuran to 2-dibenzofurylmethyl carbinol. In the pilot plant this is accomplished by high-pressure catalytic hydrogenation using copper chromite catalyst and methanol as solvent. Pressure is maintained at about 1,200 psi. by the hydrogen gas admitted to the autoclave. Reaction takes place best at temperatures between 110 and 120 deg. C. There is continuous agitation.

The reaction, most of which occurs in the first few minutes, is allowed to proceed slightly beyond the initial reduction stage so that small quantities of 2-ethyldibenzofuran are produced. This accomplishes two things.

First is the assurance that no 2-acetyldibenzofuran remains. Since the final product is used in electrical applications, this is desirable. If present, 2-acetyldibenzofuran is detrimental to electrical properties and adversely affects chain length of polymer or copolymers formed from the vinyl compound.

Second is the elimination of the difficult separation of 2-acetyldibenzofuran from 2-dibenzofurylmethyl carbinol. If desired, the 2-ethyldibenzofuran, which is only present in small amount, can be easily removed by fractional distillation. Even without any separation at this point, the 2-dibenzofurylmethyl carbinol contains no detectable amount of 2-acetyldibenzofuran and less than 1 percent of 2-ethyldibenzofuran.

Other catalysts were tried, but none was as economical as copper chromite. Platinum oxide, for example, successfully reduced the 2-acetyldibenzofuran at 90 deg. C. and 200 psi. of hydrogen, but was limited to a single reduction, since it was readily poisoned. The same copper chromite catalyst, on the other hand, has been used to carry out 20 reductions without losing its activity.

Autoclaves and Agitators

Large shaking autoclaves were neither desirable nor economical, so other types were investigated. First experiments in the pilot plant were carried out in a 5-gal. vertical autoclave, 18 in. high, with an inside diameter of 10 in., and a hemispherical bottom. It was chemically heated and operated at a 2,000-psi. pressure. Agitator speed varied from 40 to 600 rpm. Three types of agitator were tried: anchor, turbo and propeller. The turbo-agitator was tried with and without a draft tube, and with and without a gas absorber. The propeller-agitator was also tried with and without a draft tube.

Percent of ketone in methanol was varied, as was the percent of copper chromite catalyst. In all cases, height of solution in the autoclave and time length of the run were varied. There remained in all runs at least 3 percent of 2-acetyldibenzofuran and, in some cases, as much as 20 percent.

At 110 deg. C. and 1,500 psi. of hydrogen the reaction started. This is indicated by a sharp temperature rise and an abrupt pressure drop. To keep the pressure above 1,400 psi., the autoclave was opened to a gas cylinder. The material was agitated for varying periods of time at 130 to 135 deg. C. and 1,500 psi. Most of the material is reduced in the first few minutes. Continuation of the reduction beyond this point reduces a small amount of the remaining ketone and increases the amount of 2-ethyldibenzofuran formed.

These experiments suggested the possibility of completely reducing the 2-acetyldibenzofuran to the carbinol by better mixing of the liquid and gas phases through increased agitator speeds. Trial runs were made in a vertical autoclave about 2½ in. in diameter and 18 in. high, with a 1.5-liter volume. The operating pressure was 2,000 psi. Speed of the propeller-agitator was 1,700 rpm. Percentages of ketone and catalyst were varied. Conditions of the runs were agitation for 1 hr. at 135 deg. C. and 1,500 psi. of hydrogen. Less than 1 percent of ketone remained in these runs. This trace might have been converted if, after reaching operating conditions, agitation time had been extended.

Since a packing gland in a large autoclave for these high agitator speeds involves many design problems due to the tremendous stresses, and since it was not definitely known that this trace of ketone actually could be reduced by extending the length of the run, this angle of attack was abandoned.

To duplicate the agitation conditions of a bomb shaker, a horizontal autoclave was the next selection. For preliminary study, a 3-liter bomb shaker was converted to a horizontal autoclave by constructing a new head that was fitted with packing gland, thrust bearing and horizontal agitator. The agitator was constructed by cutting a length of ½-in. copper tubing along its longitudinal axis and using the two pieces as blades. The electric heating jacket, which also supported the bomb proper, was anchored to a base plate.

Four successful runs were obtained with this apparatus. No ketone could be detected in the reaction products. The autoclave was operated at 130 deg. C. and 1,500 psi. Agitator speed was 58 rpm. After operating conditions were reached the run was continued for one hour. The reaction actually started about 5 to 10 deg. C. lower than it did in a bomb shaker or vertical autoclave. Runs were next duplicated in a 5-gal. horizontal autoclave. Here again the runs were successful. No ketone could be detected in the reaction products.

Equipment Test Results

Results of these pilot-plant runs indicate that the most practical equipment for large-scale production in the reduction of the ketone to the carbinol is a horizontal autoclave with a slow-speed splash agitator. Furthermore, optimum conditions for the reduction are 1,200 psi. of hydrogen, a temperature between 110 and 120 deg. C., and a run of 1½ hr. after reaching 120 deg. C. Best catalyst concentration is 2 percent of copper chromite. Optimum weight ratio of ketone to methanol is 0.90.

In the pilot plant, 27 lb. of 2-acetyldibenzofuran, 3 gal. of absolute methanol and 1.44 lb. of copper chromite catalyst are placed in a 10-gal., steam-heated, horizontal auto-

clave. Hydrogen is admitted until the pressure reaches 1,200 psi. The mixture is heated and stirred until the temperature is between 110 and 120 deg. C. The reaction then begins. A sharp drop in hydrogen pressure gives evidence of this.

Hydrogen is again admitted until the pressure gage reads 1,200 psi. Stirring is continued for an additional 90 min. at 110 deg. C. After cooling, the reduction mixture is removed from the autoclave, filtered to remove catalyst, and the methanol removed under reduced pressure. A quantitative yield of 2-dibenzofurylmethyl carbinol with a melting point of 60-61 deg. C. is obtained.

Step Three

Third and final step in the pilot-plant process is the vapor-phase dehydration of 2-dibenzofurylmethyl carbinol to 2-vinyldibenzofuran. Aluminum oxide is the catalyst. Dehydration is carried out between 300 and 350 deg. C.

Earlier attempts to effect the dehydration by using such reagents as alcoholic potassium hydroxide or thionyl chloride resulted in monomer yields of less than 20 percent. Such mixtures present a tremendous separation problem. They are unattractive from the standpoint of production. Other methods had to be considered.

Vapor-phase dehydration of low-boiling carbinols has been known for years. Yields on these, in general, have been far from quantitative. Nevertheless, this method was tried, using new catalysts. Best results were obtained with an aluminum oxide catalyst.

Important factors in getting a quantitative reaction are temperature control, vapor velocity, column size and catalyst surface. Previous history of the carbinol is also important. If the carbinol has not been sufficiently freed from traces of acid or aluminum salts, an undesirable reaction takes place. In this reaction one molecule of water is removed from two molecules of carbinol. In the desired reaction one molecule of water is removed from one molecule of carbinol. The amount of water removed during the reaction gives some indication of which process is taking place.

When 2-dibenzofurylmethyl carbinol is dehydrated, by passing its vapor through a column packed with activated alumina, an optimum temperature is found, at which dehydration occurs quantitatively. Below this temperature some carbinol passes through undehydrated. At higher temperatures, another product is formed. It appears to be an isomer of 2-vinyldibenzofuran, but it is not polymerizable. It is a liquid at room temperature, while 2-vinyldibenzofuran is a solid, melting at 37 deg. C.

Analysis shows the same composition for these two compounds. Also, the amount of water split out represents, in both cases, one molecule of water per molecule of carbinol. Thus, it is important to keep the column temperature within narrow limits. Distillation of the carbinol in large quantities is undesirable, because with prolonged heating, some water splits off in the stillpot, the monomer forms and then polymerizes.

Even more serious is the tendency of the carbinol to condense, forming the ether. Pre-heated carbinol is therefore advantageously flash distilled up through the column. While it is possible to pass it down, this method has several shortcomings.

When the carbinol is passed down the column, any polymer or condensation product formed accumulates with the monomer in the receiver, necessitating a separation. Furthermore, when the liquid is pumped to the column top, the first part of the column must heat the carbinol to the desired temperature. This causes temperature variation in the column and prolongs the time required to heat the carbinol before dehydration. Also, the carbinol may be present in the liquid state and thus not readily dehydrated. Finally, this method increases rate of carbon formation and steps up rate of catalyst deactivation.

Dehydration Process

Therefore, a specific process was devised to meet requirements. The dehydration column is packed with catalyst and then heated to the proper temperature. The column is attached to a stillpot, which is heated to about 50 deg. C. above the boiling point of the carbinol. A 4-mm. vacuum is applied to the system.

Carbinol is then pumped into the stillpot at a controlled rate which depends upon the size of the dehydration tower. It vaporizes immediately and passes up through the catalyst. The monomer is cooled instantly, after passing through the tower. Water vapor passes through an entrainment column to separate final traces of 2-vinyldibenzofuran from it. Finally, the water vapor is ejected through a steam ejector.

This method prevents polymer or condensation product from entering the receiver or vacuum system. Premature condensation or dehydration in the stillpot is likewise prevented. Under these conditions, the reaction proceeds stoichiometrically.

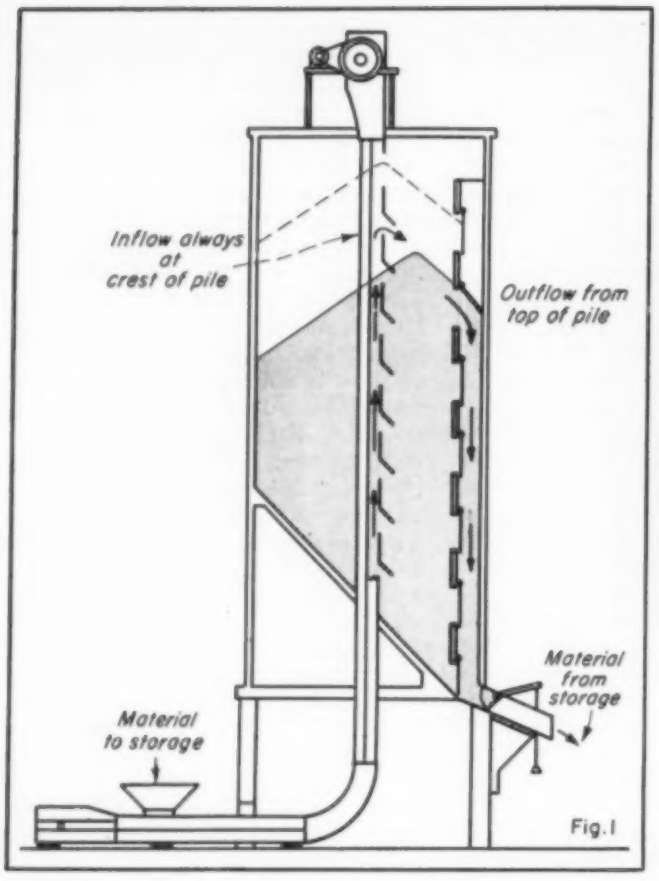
Critical factor in dehydration is temperature. Close control is essential to achieve uniformity. In the first column, heat was applied electrically to each of five sections of the column. Each section was separately controlled. However, initial addition of carbinol brought an immediate temperature drop. A run of from 20 to 30 min. was necessary to obtain constant conditions in the column.

This difficulty has been largely eliminated in the new column, which is heated by a chemical system. Initial temperature drop is now overcome quickly. The new column is 4 ft. high, has an inner diameter of 2 in. and is packed with ⅛-in. aluminum oxide pellets. Although it has been operated at capacities up to 5 lb. per hr., it is usually run at 60 lb. per 24-hr. period. Continuous operation at relatively low vapor velocities gives much longer catalyst life than operation at high vapor velocities for short periods of time.

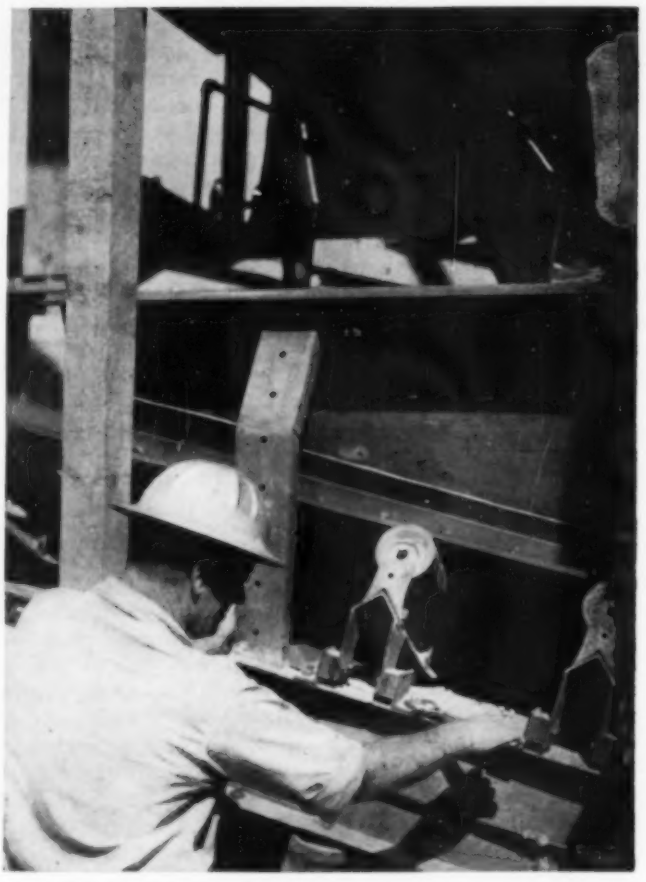
When operated for short time periods, conversion by the catalyst decreases progressively, until after four passes the yield drops to 96 percent 2-vinyldibenzofuran. When operated continuously for periods as long as a week, no drop is observed in catalyst activity as measured by percent conversion.

In the pilot plant, the previously melted 2-dibenzofurylmethyl carbinol is put into a heat reservoir attached to a metering pump. The metering pump is connected to another system. This system consists of a 12-liter copper flask maintained at 280 deg. C. and a dehydration column 5 ft. high and 2 in. in diameter. Vapor velocity is 27,600 c.c. per sec. The column is packed with 5/32-in. aluminum oxide pellets. An efficient condenser on the column cools monomer produced.

Vacuum of 4 mm. of mercury is applied to the system. The carbinol is metered into the flask at the rate of about 2.5 lb. per hr., where it is immediately flashed up through the column. Monomer is cooled immediately by passing it through the condenser and into the cool receiver. Water vapor passes through an entrainment column which removes traces of monomer and is then ejected through a steam jet. Water traces are removed from the monomer by suction filtration through anhydrous sodium sulphate. Yield of 2-vinyldibenzofuran is quantitative.



DAMAGE TO MATERIAL—This storage silo is equipped to reduce breakage of incoming and discharged material.



DAMAGE TO EQUIPMENT—Here flexibly supported idlers reduce severity of loading impact on a belt conveyor.

Materials Handling Problems

Wilbur G. Hudson
Consulting Engineer, Chicago, Ill.

Degradation of material and damage to conveying equipment are hazards to avoid in specifying equipment for materials handling applications.

TWO factors that should be considered in specifying equipment for materials handling are the possibilities of (1) damage to the material being handled and (2) damage to conveying equipment. Several case histories serve to emphasize the importance of keeping these points in mind when analyzing such applications.

Damage to Material

It is important to consider whether the type of equipment contemplated will injure the material. This applies especially in the field of pneumatic conveying, where often the material travels through the duct at a velocity approaching a mile per minute. In one case the manufacturer of a prepared roofing made of heavy paper coated with an asphalt composition and faced with slate granules, suffered considerable loss through failure to take this factor into consideration. The granulated slate is a clean screened product in ¼-in. cubes, shipped in paper-lined boxcars. The consulting engineers specified a pneumatic car unloader with a capacity of 40 tons per hr. Twin flexible hose and automatic nozzles drew the granulated slate to a 10-in. suction line extending the length of the platform, then in a long radius curve to a 90-ft. riser, to a receiver, and out through an air-lock gate to a belt conveyor.

Operating tests showed serious damage to the granules. The cubes were rounded, and as delivered to the belt, contained considerable dust. After a time, when the duct and bends became polished, the degradation was less marked but still objectionable. Court action for removal of the installation and recovery of money paid to the contractor was taken by the

roofing paper manufacturer. A cross suit by the contractor was made for final payment for the installation.

There was no question about fulfillment of the two contract guarantees—that the material and workmanship should be in accord with good practice, and that the capacity should be 40 tons per hr. In court, the manufacturer's superintendent unrolled a sheet of roofing on the floor, a beautiful runner with a clean white slate facing. Alongside it, he unrolled a sheet made with slate after it passed through the pneumatic system. It was a mottled black and grey, with slate dust mingled with granules. However the court found that the contractor was not to blame. It had been acknowledged that he had fulfilled the guarantees, and it was not his responsibility, but that of the consulting engineer, to determine whether a pneumatic system would render the slate unusable. The incident has significance for the engineering consultant.

Storage Problems

Material handling layouts frequently involve the problem of storage in a bin or silo, which entails careful consideration of the physical characteristics of the material. Some, such as cement, pulverized slate, soda ash, and various clays, pack in storage and will not flow out. To a considerable extent this difficulty may be reduced by providing air jets at critical points to aerate the material and render it flowable. In a small bin a suspended thin sheet of stainless steel at the center may prevent arching.

Fragile granular materials and briquettes may be damaged by the drop into storage. With a continuous flow elevator, successive discharge openings along the vertical run will provide discharges across the top of the pile in storage as shown in Fig. 1. Where loading must be at the top, a spiral chute or a trickler chute may be desirable.

Degradation occurs again at the outlet due to the grinding in a converging outflow. This may be eliminated by a vertical box about 24 x 24-in. in cross section, with hinged flap doors which function to assure a sliding outflow off the top of the pile. The material within the channel holds shut all hinged doors below the feed point.

Some bituminous coals heat, and may ignite in storage due to oxidation by air filtering up from the discharge gates. Fortunately coal usually does not remain long in storage and occasional change of content reduces the risk of spontaneous ignition in a bin or silo, though it does occur sometimes during long periods of storage.

Equipment Damage

A belt conveyor is vulnerable to costly injury unless suitably installed and intelligently maintained. One essential is thorough cleaning of the face of the belt after it rounds the head pulley. If there is a sticky residue a convex surface builds up on the return rolls and eventually the belt drifts out of line and may be seriously damaged by contact with the supports. Also at the tripper, an accumulation forms on the second snub pulley, throwing the belt to one side or the other.

On one installation a 36-in. belt handling sludge from washed coal proved to be extremely difficult. The usual rotary bristle brush quickly gummed up. Various rotary cleaners were tried without success. It was observed that a scraper removed some of the residue. Added scrapers did better. The device of multiple scrapers therefore suggested itself. These were arranged like a short centers flight conveyor moving slowly either in the direction of, or against, the travel of the belt. They provided practically complete cleaning of the belt. If the number of scrapers always in action is suited to the difficulty of the job, any adhesive scum can be cleared. Unfortunately the travelling cleaner cannot be located in the space between the snub pulley of a tripper. There it is best to provide a rigid scraper against the face of the second pulley to remove the slight accumulation which may get by the cleaner at the head.

Heavy Material

With heavy lumpy material the chief source of damage to the belt is the impact at the loading point if it rests on unyielding idler rolls. Fig. 2 shows the idlers under the loading chute supported through yielding rubber pads in shear. An alternative, assuring still better cushioning, are idlers formed by multiple pneumatic-tired rollers.

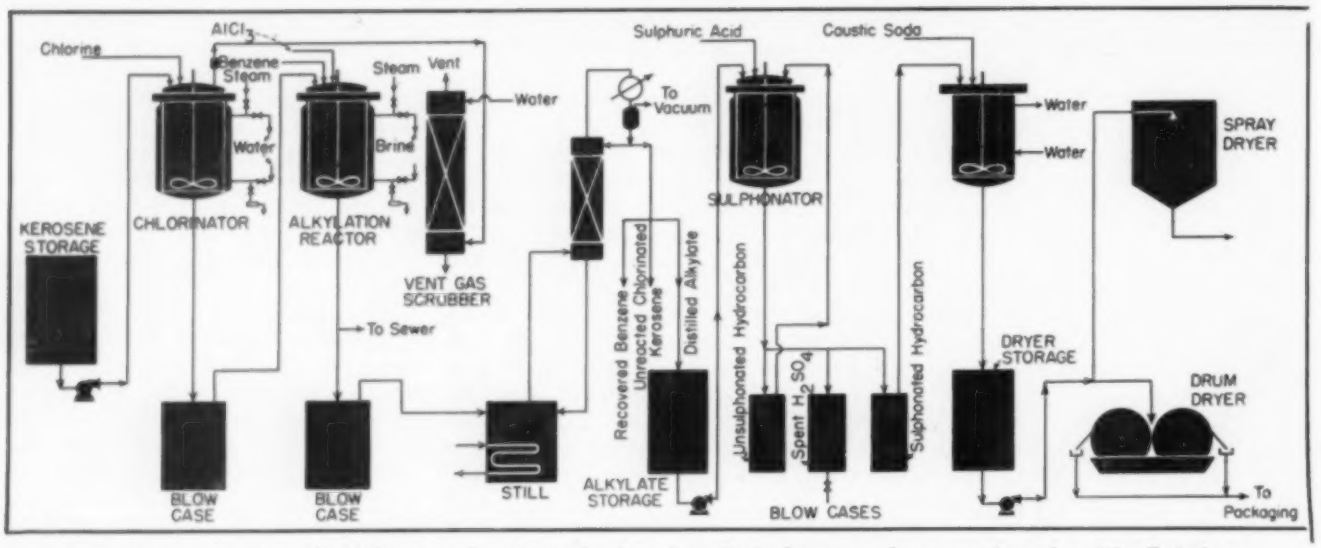
As distinguished from flowable pulverized and granular materials, some of the fragmentary materials introduce unexpected difficulties. In one plant manufacturing licorice juice for chewing tobacco, a screw conveyor was installed to dispose of the spent licorice root. The stringy roots promptly snagged between the trough and the helicoid which folded up like an accordion. In a somewhat different situation a conveyor at a steel plant, used for handling scarfs clipped from the ends of angles and flats, consisted of two strands of rivetless chain connected by spaced pusher bars which pushed the steel fragments along a plate trough. The fragments showed an uncanny tendency to find their way into the open side-links of the rivetless chains. When these links reached the head sprockets something had to give way. A protected steel strap chain would have been better.

As an alternative to conveyors with a moving element for fragmentary materials—the screw, flight, or belt conveyor—a vibrating conveyor may be much better, especially for hot slag, partially quenched coke, castings, etc. This has a steel trough of rectangular cross section, mounted on rearward slanted flat spring supports and oscillated by an eccentric drive. The effect is to bounce the material along the trough at about 50 fpm. There is negligible wear on the trough bottom since the material does not slide, and maintenance is low. The length may require tandem units. These may be inclined upward slightly to maintain floor clearance. The trough may be perforated to function as a screen. Another form, available if the distance is not too great, is a trough vibrated at high frequency by a solenoid or a pair of unbalanced pulleys geared together to produce rectilinear impulses.

Handling Capacity

A guaranteed "handling capacity" frequently leads to misunderstanding. Does a guarantee that 50 tons per hr. will be unloaded from a boxcar mean that a 50 ton car will be unloaded in one hour by a power shovel or pneumatic unloader? Then the rated capacity must be far greater than 50 tons per hr. since, while cleaning up, a substantial part of the load will be handled at 10 or 15 tons per hr. Does a guarantee that 50-ton cars will be unloaded in one hour mean that ten cars will be unloaded in 10 hours? The unloading of one car must be followed by shifting another into position, perhaps the removal of a car-door bulkhead, and preparation for starting operation therein. The actual accomplishment may be 6 or 8 cars in ten hours.

Moreover with any machine dependent on the skill of the operator, allowance must be made for fatigue. The operator of a crane, bulldozer, hoisting tower, or power shovel, can maintain a given rate for a few hours, then he must have a rest period. A good practice is to figure on a 50-minute hour when estimating the day-by-day capacity.



PLAN Generalized flowsheet for the production of synthetic detergents from petroleum by: (1) alkylating an aromatic hydrocarbon, (2) sulphonating the resulting alkyl aryl hydrocarbon, and (3) neutralizing.

Petroleum Chemical

Benzene and a kerosene distillate fraction are the usual commercial starting points for production of alkyl aryl sulphonate detergents from petroleum.

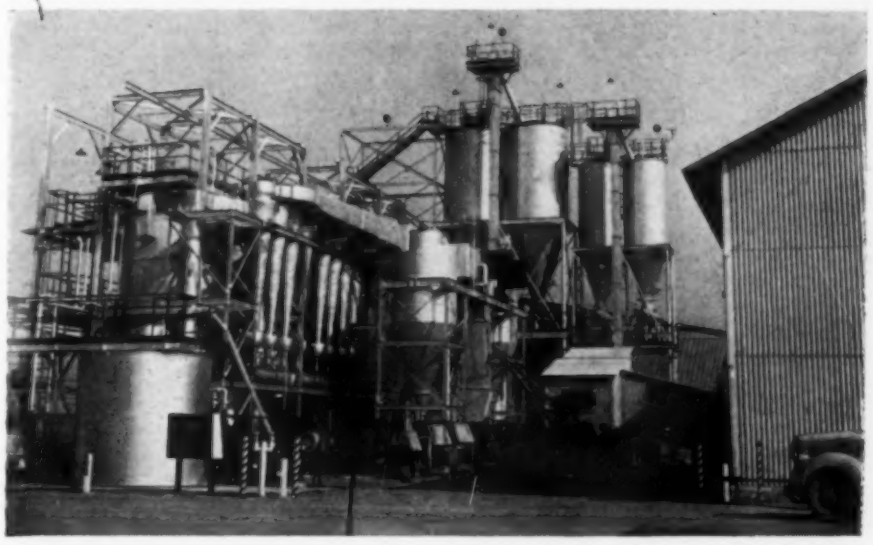
Marcus Sittenfield
Consulting Chemical Engineer, Philadelphia, Pa.

Synthetic detergent production is now one of the major industries in this country from the standpoint of tonnage. It has been estimated that the installed production capacity of all types of synthetic detergents in this country will be in the range of 700 to 800 million pounds per year by the end of 1948. Of this capacity, about 60-70 percent will be for the manufacture of detergents derived principally from petroleum products.

There are several types of detergents derived from petroleum hydrocarbons. These are the alkyl phenol sulphonates, the alkyl sulphonates and the alkyl aryl sulphonates. It is the purpose here to discuss the manufacturing methods used in preparing the alkyl aryl sulphonates, particularly the alkyl

Testing the Finished Product

The way to find out how well a synthetic detergent will wash dirty cloth is to wash dirty cloth. At the left chemist Sorrentino of Standard of California is shown preparing a testing solution for the miniature washing machine (right) which launders cloth samples. Results give a basis for comparing qualities of various compounds.

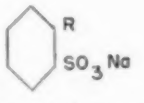


PLANT Indicative of the equipment necessary for tonnage production; detergent drying plant of Standard of California at Richmond.

Detergents

benzene sulphonates which are the most important of this class of detergents

Alkyl benzine sulphonates have the general formula as shown at the right where *R* is a saturated hydrocarbon chain containing from 9 to 18 carbon atoms. The detersive characteristics of these compounds vary both with the number of carbon atoms in the alkyl chain and with the arrangement of the atoms in the chain. As the length of the straight chain increases, detergent properties increase to a maximum, and then tend to drop off due to decreased solubility of the hydrocarbon in water. This maximum occurs with a chain length of between 12 and 15 carbon atoms.



Most of the commercial alkyl aryl detergents being sold today have a concentration of approximately 35-40 percent active material, the rest being inorganic salts such as sodium sulphate, phosphates, silicates, etc. Many detergent compounders are purchasing products containing 60 percent or higher active ingredient and blending with other surface-active agents or with inorganic salts in order to prepare products with special foaming, wetting or detergent properties.

Considering the structure of the alkyl aryl sulphonates, it becomes obvious that the following operations must be performed in their manufacture: (1) Combining an alkyl group with an aromatic hydrocarbon, (2) sulphonating the resulting alkyl aryl hydrocarbon, and (3) neutralizing the sulphonic acid thus formed. A typical flow diagram for this process is shown. It presents the steps involved in alkylating the aromatic compound, and those required for sulphonating, neutralizing and drying the final product.

In commercial practice, the alkyl portion of the hydrocarbon is derived from a kerosene distillate fraction obtained from the refining of paraffinic crudes. The boiling range of the distillate is usually between 185 and 290 deg. C. Analysis of this fraction shows that it is composed of a mixture of saturated hydrocarbons having 10 to 16 carbon atoms in the chain. The alkylation of a saturated hydrocarbon to an aromatic ring is accomplished by means of the Friedel-Crafts reaction.

Chlorination

First step is a chlorination of the kerosene fraction, a well known organic process. Temperature required for the chlorination of kerosene is between 60 and 70 deg. C. Kerosene is pumped into a lead-lined, agitated, jacketed reactor. A catalyst, usually iodine, is then dissolved in it. Chlorine gas is then passed through the liquid at such a rate as to maintain the reaction temperature. Chlorination is continued until it is calculated that the kerosene has been monochlorinated.

Alkylation of benzene is the next step in the manufacture of the alkyl aryl sulphonates. Chlorinated kerosene is reacted with an excess of benzene in the presence of catalytic quantities of anhydrous aluminum chloride in a glass-lined, agitated, jacketed reactor. The approximate molar ratios of chlorinated kerosene to benzene to anhyrous aluminum chloride used in this reaction are 1:6:0.1. The usual techniques of a Friedel-Crafts reaction are followed. After all the chlorinated kerosene has been added to the benzene, the reaction mixture is agitated for another hour or so to allow the reaction to be completed. It is then allowed to settle and the aluminum chloride sludge is drawn off.

In both the chlorination and the alkylation steps, hydrochloric acid is a byproduct. The vent gases obtained from these reactions are scrubbed in a stoneware tower with water. The resulting acid solution may then be purified.

Last step in the preparation of the alkyl benzene hydrocarbon is its purification. After the aluminum chloride sludge has been drawn off, the crude alkyl benzene and benzene mixture is distilled. First the unreacted benzene is removed and recovered, then unreacted chlorinated kerosene and other light boiling constituents are removed for recycling. Finally, the alkyl benzene is distilled off under vacuum and sent to the sulphonation, neutralization and drying steps where the dry synthetic detergent compound is produced.

Sulphonation

The sulphonation step is a simple one but at the same time it is one of the most critical. If the sulphonation is not complete, if the unsulphonated material is not adequately separated from that which is sulphonated, if the product becomes contaminated with iron, or if excessive polysulphonation occurs, the resulting detergent will be inferior.

Temperature, concentration and time of reaction are all variables. With 20 percent fuming sulphuric acid, temperatures of between 35 and 45 deg. C. for a period of about two hours have been used. When 100 percent sulphuric acid is used, reaction temperatures of between 65 and 80 deg. C. have been used for a period of about one hour. The reaction is carried out in glass-lined, agitated, jacketed reactors. The alkyl benzene hydrocarbon is mixed with about 1.25

times its weight of acid, and the reaction temperature is closely controlled.

When the sulphonation reaction is finished, the reaction mass is allowed to settle, the spent sulphuric acid and unreacted hydrocarbon layers are separated from the sulphonated compound. The sulphonated material is then drowned in ice water and neutralized with sodium hydroxide. Neutralization is accomplished in a stainless steel, agitated tank that is provided with cooling coils.

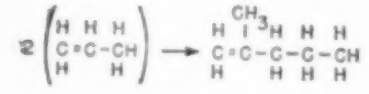
As previously indicated, the detergent properties of the alkyl aryl sulphonates vary with the number of carbon atoms in the alkyl chain. It is obvious that the alkyl aryl compound made from a kerosene fraction will be composed of molecules which have alkyl chains of varying carbon atom lengths. Consequently, the sulphonate that is obtained cannot have optimum detergent properties. Instead its properties will correspond to the average of the group. In order to obtain a distillate fraction with a closer boiling range and which will contain molecules with fewer variations in chain length, a redistillation would be required. Such an operation would increase the raw material cost tremendously, chiefly because the desired fraction would comprise a comparatively small amount of the whole.

Long Chain Preparation

Considerable experimentation has been done on this problem of large scale preparation of an alkylate that is composed of long chain paraffinic molecules of a definite number of carbon atoms, rather than a mixture of various chain lengths, such as occurs in petroleum distillate fractions.

One such process that comprises a combination of two reactions familiar to the petroleum industry, is receiving serious consideration by several of the manufacturers of the alkyl aryl sulphonate type of detergent.

In this process, the lower gaseous olefins, propylene and butylene are polymerized to form longer chain olefins, such as octene, nonene, dodecene, pentadecene and hexadecene. This polymerization reaction proceeds in the following manner forming the isoolefin:



This dimer in turn reacts with itself or with additional mono-olefins to form still longer olefin chains.

REFLECTOMETER measures degree of whiteness of materials in tests of cleaning compound developed from petroleum.

The polymerization reaction may be accomplished at comparatively mild conditions in the presence of 100 percent ortho-phosphoric acid. The conditions of reaction for propylene are 135 to 200 deg. C. temperature, 1 to 25 atm. pressure and a flow rate sufficient to give 50 percent conversion. For butylene, temperatures of 30 to 60 deg. C. and pressures of 1 atm. are used. The diversity of products obtained by polymerization varies with the severity of reaction conditions. The propylene or butylene that is used as raw material must be freed of all sulphur and other odor bearing compounds before being subjected to polymerization. The reaction products are continuously removed from the reactor, and then separated into the individual components by distillation.

Distilled olefinic polymer is then reacted with benzene in an alkylation reaction that has been used for a number of years by the petroleum industry.

Approximately 1 mol of olefin, 2 to 3 mols of benzene and 2 mols of 96 percent sulphuric acid are reacted together at 10 to 15 deg. C. for a period of approximately two hours. The reactor is glass-lined, agitated and jacketed. A glass-lined reactor is used in order to remove any possibility of contaminating the product with iron.

At the end of the reaction, the products are washed with cold 96 percent sulphuric acid and several times with water. This operation is necessary in order to remove any esters which may have been formed during alkylation.

Washed alkylate is then fractionally distilled so as to remove the unreacted benzene, any unreacted olefin, highly polymerized tars, and obtain a purified compound. This purified alkylate, which is now composed of molecules of equal molecular weight, rather than a mixture which is obtained in the earlier process starting with kerosene, is then sulphonated in the same manner as has been described previously.

Processes required for making the alkyl benzene hydrocarbon are comparatively complicated, particularly if the newer method of using olefin polymers is being considered. The investment cost and the availability of raw materials make this process admirably suited for petroleum or petroleum chemical companies to exploit.

Actual preparation of the active compound, by sulphonation and neutralization of an alkyl aryl hydrocarbon, is quite suited to the small soap processor who wishes to enter the synthetic detergent field by manufacturing a specially blended material.

A plant to process about 30,000 lb. per 24-hr. day of 60 percent active material can be installed at a cost of between $75,000 and $85,000. A major part of this installation cost is the drying equipment needed.

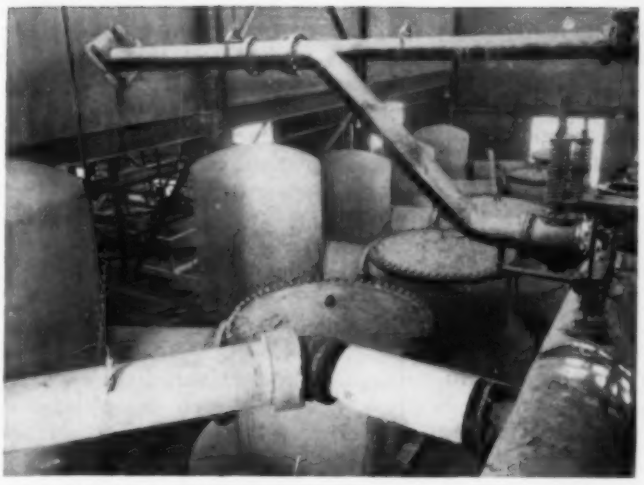
Manufacturing Costs

Costs for the manufacture of a 60 percent active detergent, in a plant of the size previously mentioned, have been calculated to be approximately 14c. per lb. A breakdown of this cost is presented in the accompanying table. The approximate manufacturing cost to produce a 40 percent active detergent has been calculated to be 10c. per lb.

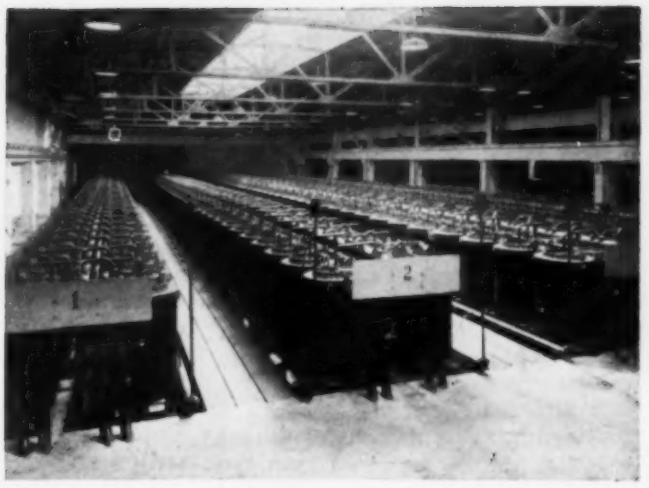
Approximate Costs for the Manufacture of a 60 Percent Active Detergent

Chemicals (alkyl aryl hydrocarbon, sulphuric acid, caustic soda)	$0.10
Utilities (water, steam, power)	0.01
Labor and supervision	0.01
Packaging material	0.01
Fixed charges (depreciation, overhead, maintenance, insurance, taxes, etc.)	0.01
Total, per lb. of product	$0.14

Naturally, these manufacturing costs will vary depending on the amount of material made per day, the actual design of the plant, changes in the price of raw materials, labor and other factors. It is estimated, however, that a manufacturer who desires to process as little as 6,000 lb. per day of synthetic detergent can effect substantial savings by installing a small sulphonation, drying and packaging plant. At present price levels, a manufacturer could pay off the cost of his plant in a period of a few years.



CHEMICAL RECOVERY—Black liquor is concentrated in multiple effect evaporators, burned in recovery furnace.



CHLORINE PRODUCTION—Electrolytic cells produce chlorine and caustic soda (from brine) for use in bleaching.

INTEGRATED INDUSTRY—New sulphate pulp mill, bleach plant, and electrolytic chlorine-caustic unit with the rebuilt groundwood mill, paper machines, and hydroelectric plant gives Espanola a well rounded industry.

Bleached Kraft Pulp

"CHEM AND MET" PICTURED FLOWSHEET ON PAGE 136

Kalamazoo Vegetable Parchment Co. redesigned and rebuilt the abandoned Espanola newsprint mill, to utilize abundant natural resources such as wood and waterpower

Richard W. Porter
Assistant Editor, *Chemical Engineering*

MANY are the ghost towns that dot the countryside as bleak reminders of once flourishing industry. Rarely, however, do ghost towns revive from their decadence; most of them fall never to rise again. One exception is Espanola, Ont. Knocked out by the shutting down of its newsprint mill during the depression, this single-industry town drifted for a decade and a half until it was revitalized by a new spirit of vision and enterprise. Once abandoned, the old mill has been redesigned and rebuilt and is turning out over 250 tons per day of bleached sulphate pulp, 40 tons of groundwood and 150 tons of paper.

Early in the war, the Kalamazoo Vegetable Parchment Co., Parchment, Mich., decided to strengthen its position by manufacturing its own pulp requirements. After investigating different locations throughout the U. S. and Canada, KVP found Espanola, Ont. a most desirable site to carry out its expansion program.

For here, within 500 miles of the home plant, was an idle paper mill and water power development, a plentiful supply of wood, and good rail and water transportation facilities. Construction of a modern sulphate pulp mill, bleach plant and an electrolytic chlorine-caustic plant, together with the rebuilding of the old mill has made possible the fullest utiliza-

tion of the two prime natural resources, namely (1) abundant stands of readily available jack pine and (2) hydroelectric power.

But it is from the Spanish River that the Espanola Mill draws its greatest natural advantage. The river and its tributaries tap a substantial portion of the nearly 5,000 sq. mi. of KVP timber holdings to provide cheap transportation for a bulk of the wood used by the mill. Equally important is the more than 20,000 hp. obtained from the water power plant that supplies the complete power requirements of the mill and the electrolytic plant. On top of this, many millions of gallons of water per day are taken from the river for process use.

Conversion of the old newsprint mill to a modern bleached sulphate mill required complete redesign in order to utilize fully as possible the old facilities. Much of the original equipment was rebuilt and used again including paper machines, conveyors and wood handling equipment, part of the old ground wood mill, steam boilers and hydroelectric generators. Major new building was put up to house the new sulphate pulp mill. This article emphasizes only the new installations.

Wood Preparation & Pulp Making

Received by water, rail or truck the wood is sorted as to specie, cut into 4 ft. lengths and the bark removed in large dry-operating barking drums. Dry bark and sawdust are transferred by dump cars to a fuel hopper in the boiler plant and the stripped wood is either sent to the outdoor storage pile or is converted directly to chips. Chips are screened and stored in three reinforced concrete silos, 35 ft. dia. x 74 ft. high.

Under each of the hopper bottom silos a belt conveyor receives chips from the "star" feeders and discharges to a long conveyor belt that transfers the chips nearly 500 ft. through an 8 ft. dia. welded steel tube which rises from the bottom of the silos to the top of the digester building. An automatic scale at the foot of the inclined conveyor measures the weight of chips delivered to each digester. Chips discharge from the conveyor direct into each digester eliminating the need for intermediate overhead hoppers. The chip delivery system is remotely controlled from the digester room.

Pulping takes place in five 9-ton stationary digesters using an indirect heating system. Digesters loaded with chips are charged with cooking liquor by means of an automatic measuring system, controlled from a panel board.

The liquor throughout the cooking cycle is continuously circulated and heated, being withdrawn from bottom of digester, pumped through a heat exchanger to increase its temperature, and from there back into top of digester.

Complete circulation of the total charge of liquor takes about 10 min. while the total cooking time is about 4 hr. Indirect heating, while it lengthens the cooking cycle tends to produce a stronger more easily bleached pulp. Operation of each digester is automatically and individually controlled. During operation the digesters are vented and the top relief gases are condensed with provisions made to recover about 200 gal. per day of crude turpentine.

When the cooking cycle is completed the push button controlled discharge valve at the bottom of the digester is opened from the operating floor and the contents blown to the top of the blow tank. Flash steam from the blow tank passes to an accumulator from which the hot condensate is drawn for use in heating clean process water.

Worth noting is the arrangement of the digester room. Digesters are installed in a semicircle about the central blow tank. The chip conveyor terminates at a point above the blow-tank and the chips fed to five digesters via any one of five spouts. High efficiency results from the maximum use of automatic control, and the remote control of digester loading and discharging.

Pulp and liquor from blow tank is screened to remove knots and then passed over rotary vacuum washers to separate the spent cooking liquor from the pulp. Liquor is then passed through evaporators and sprayed into a furnace in order to recover the chemicals. The pulp is passed over rifflers, screens and deckers in order to remove heavy dirt and shieves and to thicken prior to bleaching.

Bleaching

A six stage bleaching system combining both continuous and batch operation at high and low consistencies is employed. The first three stages and the fifth stage operate continuously and at low density while the fourth and sixth are batch operations at high consistency. For all practical purposes, the system can be considered as continuous. Tile lined bleach towers are used for all except caustic cook where steel tanks are used. Bleaching towers are equipped with a screw feed running down the center and the pulp is circulated from bottom to top. After each stage the pulp is washed and thickened on a vacuum washer. Sinces the high density stages operate at about 12.5 percent consistency, the pulp is transported from the washers to the fourth stage (caustic extraction) and to the sixth stage by means of rubber belt conveyors.

The pulp is chlorinated directly in the first stage where the average retention time is 1 hr. After washing, bleach liquor (calcium hypochlorite) is added in the second stage (retention time 1½ hr.) using lime or caustic to regulate pH. In the third stage a combined chlorine and calcium hypochlorite bleaching action takes place. The third stage washer thickens the stock to high density and it is transferred to the batch operated caustic extraction units. Four caustic cookers operating on a 1 hr. cycle are required to receive the output of the preceding continuous system. Caustic requirements are about 2 percent by wt. of the pulp on an air dry basis.

Treatment of the partially bleached pulp with caustic is necessary to obtain permanent high brightness. Since chlorinated lignins are soluble in alkali, this treatment readily removes these color impurities. At the end of the caustic cook, dilution water is added and the stock pumped to the washer. From here it is treated in the fifth stage (retention time, 1 hr.) with bleach liquor at low consistency. The final stage is again a batch operation at high consistency wherein treatment with bleach liquor and caustic removes final traces of color. Six bleach towers are employed here where the retention time is about 2½ hr. The stock is then diluted, washed and the final bleached pulp, having a G. E. brightness of 80, goes to the bleached stock chest.

Approximately 200 lb. of chlorine per ton of pulp is required (40 percent as calcium hypochlorite and 60 percent as chlorine gas). Roughly, 80 to 90 percent of the total output of the sulphate pulp mill is fully bleached as described above while the remainder may be semi-bleached or left unbleached.

Except for current requirements of the paper machines, all slush pulp is either dried or made into wet laps for storage or shipment. Two Kamyr machines and three wet machines are employed. Stock to the Kamyr forms a thick sheet on a cylinder mold then passes through presses for water removal before being dried on steam heated dryer rolls. The continuously moving sheet discharged from the dryers is automatically cut and piled before

being baled. The new 160 in. wide Kamyr, used only on sulphate, operates up to 70 fpm. with a production rate of over 175 tons per day. It is equipped with pneumatic loaded presses, predryer and a double bank of vertical stock dryers. A second Kamyr machine, 94 in. wide, together with three wet machines, are piped to handle both sulphate and groundwood.

Recovery Process

Weak black liquor, separated from the pulp in the brown stock washers, contains about 15 percent solids and is concentrated to about 55 percent solids in a six body quintuple effect evaporator. About 50 percent of the solids is combustible organic material and the remainder comprises inorganic chemicals that are subsequently recovered and reused. Heavy black liquor discharges from the evaporator to storage chests from which it is pumped through a cascade evaporator and then to the recovery furnace.

In the cascade evaporator, paddle wheels revolve slowly to bring the liquor in intimate contact with hot gases from the recovery furnace. Not only does this further concentrate the liquor to about 65 percent solids but helps scrub out some of the solids carried with the flue gas. Concentrated black liquor is then pumped through a small mixing tank where salt cake makeup is added before the liquor is charged continuously to the recovery furnace. Here the organic matter in the liquor is burned off and the inorganic salts such as sodium sulphate are reduced to sulphides and other sodium compounds are converted to sodium carbonate.

When the liquor is burned, most of the inorganic material settles to the bottom of the smelter pot while a considerable amount collects on the tubes of the waste heat boiler and some is carried on with the gas stream. Dust is removed from the tubes by automatic blowers and provisions is made for manual lancing to remove any slag formations. Part of the solids blown from the tubes settles to the bottom of the furnace but most of this material is subsequently collected in an ash hopper and dissolved in weak black liquor.

Even after passing through the cascade evaporator the flue gas contains a large amount of chemical dust. Bulk of this is recovered by passing the gas through an electrostatic precipitator. Recovered material is returned to the furnace and the dust free gas passes out the stack to the atmosphere.

Molten salts (sodium carbonate and sodium sulphides) with organic material burned off discharges continuously from the smelter pot at the bottom of the recovery furnace. It drops into a dissolving tank, containing weak wash from the causticizing plant, to form green liquor. Containing all recovered chemicals plus salt cake makup (as sulphides) the green liquor is then clarified and causticized to form the final white liquor used for pulping.

White liquor is made by the Dorr continuous process. First, green liquor is passed through a clarifier where undissolved solids or dregs are settled out. Dregs are washed and discarded while the wash liquor is held until needed for use in the dissolvers. A small portion of the clarified green liquor is used to slack the lime and the slurry so formed is mixed with green liquor in the series-connected causticizers. Here the soda ash in the liquor is converted to caustic, and calcium carbonate precipitates out as a fine sludge. The slurry so formed is pumped to the continuous white liquor clarifier. Clear white liquor is taken off to storage and the mud is pumped out the bottom by means of diaphragm pumps. The lime mud is washed in a second clarifier; clear wash liquor goes to the weak wash tank and the mud is pumped from the bottom to a rotary vacuum filter where it is dewatered to about 55 percent solids. Filtrate is returned to the mud washer and the sludge cake feeds into an oil fired rotary kiln where the calcium carbonate is burned to the oxide. Combustion gases from the kiln are scrubbed to prevent atmospheric pollution and to prevent loss of material. Recovered lime is sent to storage from which it is fed to the slacker and reused. New lime is added to make up for losses.

Chlorine Plant

One of the important new units of the mill is the electrolytic chlorine plant. It supplies a bulk of the chlorine used for bleaching as well as caustic soda requirements. Designed to produce 15-17 tons per day of liquid chlorine and an equivalent amount of sodium hydroxide, this unit was made possible by the availability of cheap waterpower. Direct current for the cells is supplied by a 1,750 kw., 300 volt generator powered by a 2,300 hp. water turbine.

Salt from storage is made into brine and treated with soda ash to precipitate impurities such as calcium. Clear filtered brine passes to the cells where it is electrolytically decomposed to chlorine gas, hydrogen gas and caustic soda. Six circuits of 78 circular cells are employed.

Chlorine gas from the cells is cooled and then dehydrated with sulphuric acid in drying towers. The gas is compressed to 30 psi. and passes through an acid separator and then a coke scrubber before being liquefied at about −5 deg. F. Liquid chlorine is then stored in three 50 ton capacity cork insulated tanks. From storage, the liquid chlorine is pumped with dry compressed air to the bleach plant and to the bleach liquor unit.

Cell liquor from the cells, consisting of 10 percent solution of sodium hydroxide plus undecomposed salt, is then evaporated to 50 percent solution by means of a double effect multicirculation evaporator. The evaporation plus cooling after the evaporation precipitates the salt which is separated from the 50 percent caustic solution by rotary vacuum and leaf type filters. The recovered salt along with new salt is then dissolved to furnish brine for the cells, and the caustic is used in the bleach plant along with the chlorine for bleaching.

Utilities

Manufacture of bleached pulp requires clean color free water. This made it necessary to install a water filtration plant to remove coloring matter from the river water and thus prevent discoloring the highly bleached pulp. Nearly 10,000,000 gal. per day are treated in two Dorr clariflocculators. Alum is used as a flocculating agent to remove finely divided solids from the water. Clarified water is then passed through sand filters to the clear well after which it is chlorinated before being pumped to points of use.

Installation of a new water turbine and generator unit brought the capacity of the power plant to over 20,000 hp. which supplies the complete requirements for the mill and town. Steam, however, is supplied from four sources. (1) a 5,000 kw. electric boiler that utilizes excess hydroelectric power, (2) two bark burning boilers, (3) black liquor recovery furnace and (4) three coal fired boilers. Except in winter when the heating load is high, the coal fired units are not needed.

Acknowledgment

Acknowledgment is made to R. A. Hayward, president of Kalamazoo Vegetable Parchment Co., for permission to publish this article and to members of KVP organization for their help and cooperation in supplying data and background information.

EDITORIAL VIEWPOINTS

Sidney D. Kirkpatrick and Staff

Over-Guessing Preparedness

How will the new armament program affect the process industries? And when? The best advice from our Washington observers is that this is no time to be stampeded by frantic newspaper headlines and congressional debates. Let's look at one or two simple facts:

The maximum new spending in the early future on preparedness is expected to be $4 billion per year. Approximately half of that will be for aircraft. Much of the other half will be for personnel training, equipment and subsistence. No huge sums are yet allocated to industrial manufacture that will affect most chemical enterprises.

What is important, however, is that the mobilization patterns are being set for both industry and manpower. They are certain to have long-time effects and, therefore, should not be shrugged off as of little consequence under present conditions. There may come a time when a mere token rearmament program will have to give way to something comparable to wartime peaks. Meanwhile, keep your powder dry, but make sure that the old musket does not go off half-cocked!

A Popular Appointment

WHY an able chemical engineer should agree to leave a deanship in an important university and get into the rough-and-tumble of a TVA directorship is one of the current mysteries of our profession. But Harry A. Curtis is not the sort to settle down too long in the comforts of an academic job. His record over the years rivals the peripatetic teachings of Aristotle. Government, industry and university have shared about equally in his distinguished career as a chemical engineer. Now at an age when he might at least be thinking about retirement, he accepts a presidential nomination for a full 9-year term to succeed 81-year-old vice-chairman Dr. Harcourt A. Morgan, former president of the University of Tennessee. The prospects are that this nomination, like many others made by President Truman, will be in for tough sledding before Senate approval is forthcoming. But we seem to recall that it was a Republican president who first appointed Dr. Curtis to the Muscle Shoals Commission in 1926 and thus started him in the paths of public service.

Personal Pensions for Professional People

INCOME TAX reduction, passed over the President's veto early this year, gives some recognition to the need for encouraging sources of risk capital. But the tax bill makers did not consider one of the serious problems that faces the individual taxpayer, particularly the technical man.

Historically, the technical man invests heavily in his education, has some lean years at the start, gets most of his income in the 35-50 age period, and retires (or wants to) about 60. Unless his company has a liberal pension plan, one of his big problems is to provide large enough savings to be able to retire. Present tax structures, based solely on annual returns, tend to tax us most heavily during the years when maximum savings might be accumulated.

An apparently unconsidered proposal by Harry Silverson of J. K. Lasser & Co. is aimed at alleviating the present condition. Under Silverson's proposal, each taxpayer could buy out of his yearly earnings tax-free government bonds, up to 15 percent of his income or $10,000—whichever is higher. No income tax would be due on this income until the bonds are cashed. The money would become taxable income in the year the bonds are redeemed. In this way the technical man, relying primarily on salary income, could in effect set up his own pension fund. He would buy bonds in the 35-50 period and redeem them after retirement.

The proposal seems to have been neglected by the Congressional committees working on the over-all tax structure. But we believe it has sufficient merit to warrant careful study and debate, especially by groups of technical men and professional people. If you want an additional statement of the Silverson plan, let us know and we will get you a copy.

More Price Confusion

SUPREME COURT decisions sometimes clarify the law. The recent decision in the Cement Institute case seems to have caused more confusion than clarification. But there are a few factors of interest to chemical industry that have been better delineated by this important case.

Six of the Justices appear definitely to have doomed practically all of the applications of the basing-point system of pricing industrial goods. The principle discussed at length by this Court majority would seem to make all normal operations of the basing-point method a definite violation of the Robinson-Patman Act.

But those who review the case can find two definitely comforting features. The decision of Justice Burton, a minority of one, seems to indicate that even the majority has not closed all doors on pricing which may permit a more distant supplier to do business with a customer successfully in competition with a nearby supplier. Indeed, the majority does not deny this privilege even when it takes the form of certain freight allowances. The distinction seems to be that while a system practiced constantly to that effect is not tolerable, an individual company, free of collusion, can undertake occasionally

to get business by offering more than normal discounts for freight equalization.

Buyers as well as sellers of industrial goods will have to study the Cement Institute decision. It may require new buying as well as new selling practices in order to take maximum advantage of legal competitive situations. Incidentally some very friendly commentators point out that the Court did not make a sharp distinction between one trade practice and another, "possibly because they did not really understand the methods of modern industrial selling."

For Fresher Figures

FROM TIME to time we all have use for chemical statistics, and we are always disappointed when we don't find the ones we want or discover that they are badly out of date. But how many realize that we all share in this responsibility?

Many segments of chemical industry are currently receiving questionnaires from fact-gathering bureaus of the federal government. Most come from the Census Bureau, the Bureau of Mines, and the U. S. Tariff Commission. All are important, but we are told that Tariff Commission data for its annual report on synthetic organic chemicals are very slow in coming in, especially from some of the larger companies. Prompter response will help to speed up the process of supplying industry with figures that are still fresh enough to be helpful. Projects of your own company may in turn be speeded up by having more up-to-date information.

The Late "K.B.Q."

LORD MOULTON once said that no one man in Great Britain did more to win the first World War for the Allies than a certain American chemical engineer, then known around the world by the cryptic initials "K.B.Q." Thirty years ago Kenneth Bingham Quinan, C. H., retired to his beloved farm in South Africa where notice of his recent death may have escaped the attention of old friends in the United States.

Born in New Jersey, where he received his early education, Kenneth Quinan started his career in California as a plant chemist and engineer. About 1900 he went to South Africa to become the chief chemist of the Cape Explosives Works. Promotions followed rapidly and he was general manager when war broke out in 1914, and Lord Moulton, as chairman of explosives for the Ministry of Munitions put in an urgent call for his expert assistance. Realizing the inadequacy of manufacturing facilities and experienced personnel in Britain, he turned to America and quickly organized a tremendous program for the production and transportation of military explosives. Then he directed his attention to England, and by June 1915 the great TNT works at Oldbury and later those at Queensferry and Gretna, were producing in greater volume than we ever thought possible.

Although long since retired, some of us have a vivid memory of K.B.Q.'s participation in the first International Chemical Engineering Congress in London in 1936. The peculiar pungency of his language and the vigor of his personality were still very much in evidence. We share with our British brothers their sorrow in the passing of this colorful leader of our profession.

Johnny Come Lately

JUST as we were remarking that Mississippi would have to import many chemical engineers to man her rapidly developing process industries, word comes that the state university will soon be set to offer four options in chemical engineering. Next fall some new and novel curricula will provide training in "technological, biochemical, administrative and military chemical engineering." The first option follows the standard pattern, with heaviest emphasis on science and technology. The biochemical option is designed to prepare for careers in food and drug processing. The administrative and military options are offered in conjunction with the School of Commerce and the campus ROTC and NROTC units. It remains to be seen whether such undergraduate specialization can turn out the qualified chemical engineers needed by Mississippi's industries. It runs counter to the trend but as a bold experiment it will be watched with interest by all.

At the Grass Roots

CHEMICAL engineers are optimists—as well as good husbands. Despite the threatened railroad strike and in the face of crowded conditions in Cleveland's better hotels, the American Institute of Chemical Engineers held a most successful regional meeting, May 9 to 12. Six half-day technical sessions and a dozen plant trips attracted almost a thousand members and guests. Nearby Akron, led by Wm. I. Burt, sparked an excellent symposium on chemical engineering development in the synthetic rubber program. Chairman R. D. Hoak of the Institute's Committee on Industrial Waste presented an all-day program of nine important papers on these pressing problems of our industries. J. M. Weiss and C. F. Prutton presided at the closing day's sessions devoted to diversified chemical engineering projects.

The keen interest and enthusiastic attendance at these regional meetings seems ample proof that the Institute is moving in the right direction. Today's trend is strongly away from tremendously large national conventions, necessary as they may be under certain circumstances. It is time to take account of the need for strengthening the grass roots of our profession.

Low Man on Totem Pole

AMERICAN MEN OF SCIENCE is sending out a questionnaire for its eighth edition that greatly exceeds in complexity the worst of the governmental soul-searchers. It's literally five feet long! Its purpose is to supply the National Research Council with information that will bring up to date the aging data of the National Roster. With that we have no quarrel, but we are disturbed and disgusted to find that the chemical engineer rates as low man on the totem pole. Chemical engineering is listed as one of the very minor subdivisions of chemistry with no separate classification for any branches or fields of specialization. Does this sound like the work of a so-called "pure" scientist? It was.

THE PLANT NOTEBOOK

Theodore R. Olive, ASSOCIATE EDITOR

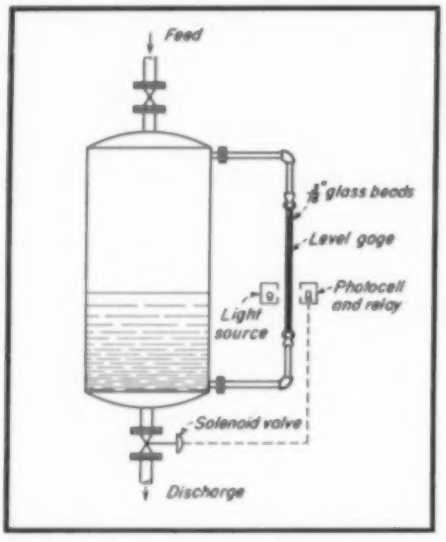


Fig. 1—Arrangement of photocell and bead-filled gage

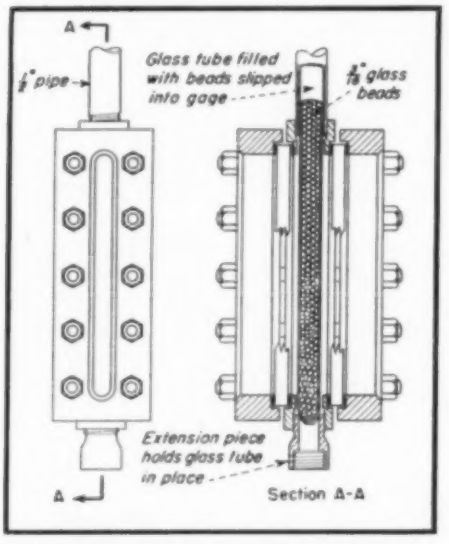


Fig. 2—Tube full of beads inserted in high-pressure gage

Photoelectric Control Adapted to Colorless Liquids

A. FARKAS
The Barrett Div., Allied Chemical & Dye Corp.
Philadelphia, Pa.

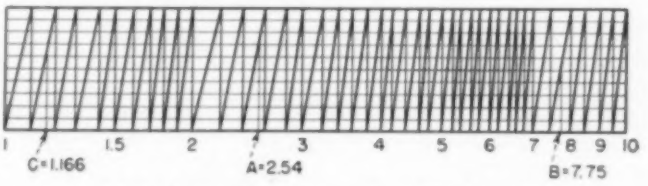
April Contest Prize Winner

AN ORDINARY level gage can be converted into an effective photoelectric level control for transparent, colorless liquids by the simple device of putting glass beads into the tube. In the case of colorless liquids without the beads, there is ordinarily not sufficient difference in light transmission through the liquid, as compared with that through the space above the liquid, to operate a photoelectric control. When beads are present, if the gage is empty, much of the light passing through will be scattered because of the difference in refractive index between glass and air. When it is filled with a liquid having a refractive index approximating that of air, a considerable part of the light will pass through, and much less of the light will be scattered.

How to Use Beads

The gage glass should be filled with beads, e.g., $\frac{1}{16}$ in. beads for a $\frac{1}{4}$ in. glass. Then, as in Fig. 1, a photocell is mounted on one side of the gage with the light source on the other side. Suitable slits and shields are provided to allow only light which has traveled through the glass to reach the cell. The difference in light passing when the tube is empty, as compared with a filled tube, is sufficient to actuate the cell. The cell can be combined with a relay in the usual way to actuate a solenoid valve which, in turn, controls the feed or discharge line and can thus keep a predetermined level in the vessel within $\frac{1}{4}$ in.

Typical relays for the arrangement of Fig. 1 might be the CR 7505K108 relay of General Electric Co. or the No. 8327 of United Cinephone Corp. For high-pressure work the beads can be put directly into a high-pressure level gage, or a preferable arrangement, as in Fig. 2, is to put them into a glass tube installed in the gage. It is possible, of course, to regulate the level accurately by moving the light source and cell.



Method of subdividing a logarithmic scale

Method for Subdividing Logarithmic and Other Non-Uniform Scales

M. A. GOVINDA RAU
Professor of Chemical Engineering
University of Madras, Madras, India

IN READING nomographs and other computation charts which may have non-uniformly divided scales it is often necessary to read correct to one-tenth of a scale interval. In non-decimal systems, such as certain currencies, it may be

May Prize Winner

A $50 prize will be issued to

H. Richardson

Research Corp., Bound Brook, N. J.

For an article presenting a set of slide rule scales for gas calculations. These include all those normally needed for gas volumes, dust concentrations and vapor pressures. This article is the winner of our May contest.

This article will appear in our July issue. Watch for it!

necessary to read to some fraction other than one-tenth, e.g., to 1/12th of a shilling or to 1/16th of a rupee. A simple method for such interpolation is to draw two parallel scales of the type in question with 10 (or 12 or 16, as the case may be) straight parallel lines between them, as with the log scales in the accompanying figure. Main divisions are then connected diagonal-wise as shown. Any point such as *A* can be projected on to its corresponding diagonal and its value read by interpolation between the parallel lines. *A* thus has the value of 2.54. When the parallel interpolation lines are uniformly spaced with a log scale a slight error is introduced in the lower range of the scale, but this error almost disappears in the upper part of the scale. Point *B* for example can be read accurately to 1/100 of a division as 7.75, but with point *C* the last decimal place in the interpolated value of 1.166 is not known accurately. With uniformly divided scales, of course, there is no such cause for inaccuracy.

Visual Control of Smoke Stacks

W. H. TELL
Houston, Texas

SMALL industrial concerns having their own power plants sometimes have trouble in complying with local smoke abatement laws because the numerous duties of the boiler operator prevent him from watching his combustion conditions as closely as he should.

A very simple way to encourage him to keep an eye on his stack is to provide a means for quick visual check on the smoke density. As a good substitute for a photoelectric smoke density indicator a peep hole can be provided in the stack, with a strong source of light behind a window on the other side of the stack. Although an experienced man can judge his smoke density properly without other aid, the use of a filter that will cause the light to black out completely at the limit of acceptable density is a better way to insure good results.

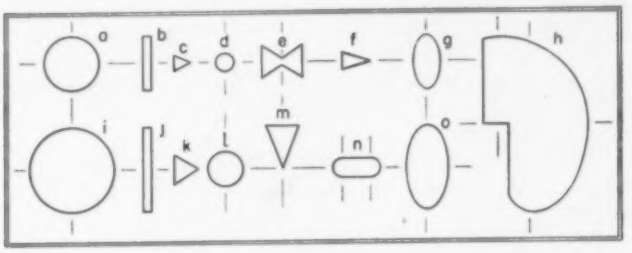


Fig. 1—Template for standard piping symbols

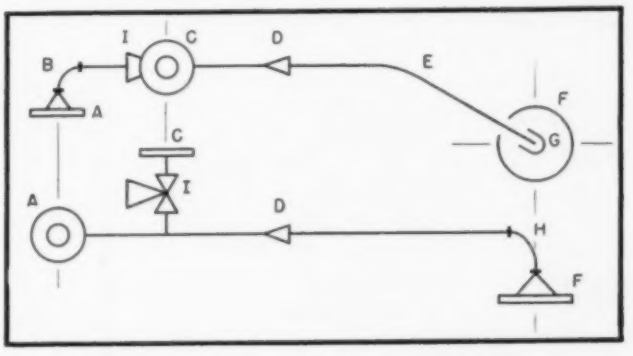


Fig. 2—Pipe spool details made with template

Template of Piping Symbols Speeds Process Piping Layout

GEORGE F. SAUNDERSON
Engineer, Redondo Beach, Calif.

SHOWN here is a gadget that I found very handy in my drafting board days. The template of Fig. 1, which can be made of $\frac{1}{32}$-in. plastic, standardizes the symbols and at the same time greatly speeds up the tedious job of drawing penciled pipe spool detail sketches. A typical pipe spool detail that can be drawn with the template is shown in Fig. 2.

Referring to Fig. 2, *A* indicates a welding neck flange and is drawn with cut-outs *b* and *c* in the top view, and cut-outs *a* and *d* in the lower view. *B* indicates a welding elbow drawn with a quadrant from cut-out *a*. *C* indicates a

$50 Cash Prize For a Good Idea!

Until further notice the editors of *Chemical Engineering* will award $50 cash each month to the author of the best short article received that month and accepted for publication in the Plant Notebook. The winner each month will be announced in the issue of the next month: e.g., the June winner will be announced in July and his article published in August. Judges will be the editors of *Chemical Engineering*. Non-winning articles submitted for this contest will be published if acceptable at our usual space rates.

Any reader of *Chemical Engineering*, other than a McGraw-Hill employee, may submit as many entries for this contest as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 300 words, but illustrated if possible. Articles may deal with any sort of plant or production "kink" or shortcut that will be of interest to chemical engineers in the process industries. In addition novel means of presenting useful data, as well as new cost-cutting ideas, are acceptable. Address Plant Notebook Editor, *Chemical Engineering*, 330 West 42nd St., New York 18, N. Y.

slip-on or screwed flange drawn with cut-outs a and *d* in the top view and *b* in the lower view. *D* indicates a reducer drawn with cut-out *f*.

Detail *E* indicates a pipe bend drawn with the upper half of cut-out *h*. (The lower half of cut-out *h* is used for indicating bends obliquely.) *F* indicates a weld neck flange of larger size than *A* and is drawn with cut-outs *j* and *k* in the lower view and with *i* in the top view. *G* indicates a change in direction and is drawn with cut-out *n*. *H* is a weld elbow shown obliquely and is drawn with a quadrant of cut-out *g* or *o* (these cut-outs also being used to show flanges obliquely). Finally, *I* indicates a screwed or welded valve drawn with cut-outs e and *m*. (To indicate a flanged valve, use cut-outs *e*, *m*, and *b* or *j*).

To make the template, trace the cut-outs with a divider point on ⅛ in. plastic and then break out the portions within the lines. Fine sandpaper will smooth the edges, as well as the outer edges which can be used for drawing straight lines. Center lines scratched on the surface and filled with black ink are helpful.

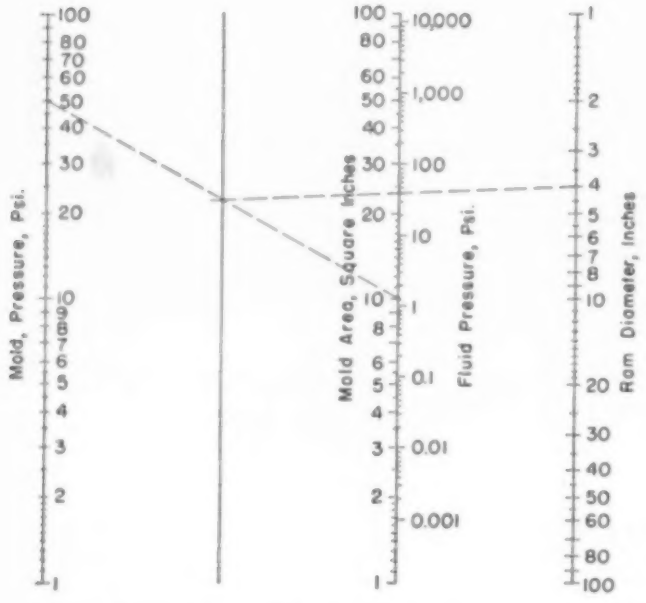


Chart for molding pressure conversions

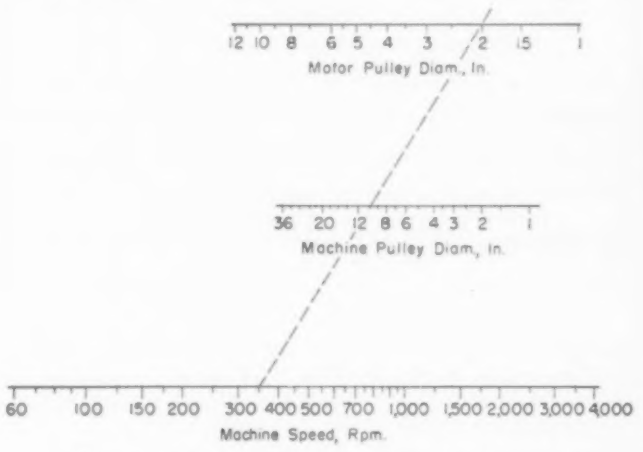
Chart Solves Pressure Conversions for Hydraulic Presses of Any Ram Size

HAROLD R. FRISBIE
Junior Technologist, Shell Oil Co.
Martinez, Calif.

IN THE "Plant Notebook" for January 1948 E. H. Ten Eyck, Jr., presented a nomographic chart for making pressure conversions in molding operations. However, the chart was good only for presses having a 10-in. diameter ram, and the author explained that it was necessary to make other charts for rams of other diameters.

This is true, provided that the "Z" type of chart is used. It is possible to make a single chart of the sort presented here which permits conversions from fluid pressure to total mold pressure for any size of ram. The chart solves the equation $P_m A_m = P_f A_r$ where P_m is the unit mold pressure, A_m is the mold area, p_f is the unit fluid pressure, and A_r is the ram area, all in consistent units. Since $A_r = D_r^2\pi/4$ the chart can be based on the use of the ram diameter rather than area.

To increase the range of the chart either pressure scale can be multiplied by 10, 100 or 1,000, in which case the other pressure scale must, of course, be multiplied by the same amount.



Belt drive selection chart for 1,750 rpm. motors

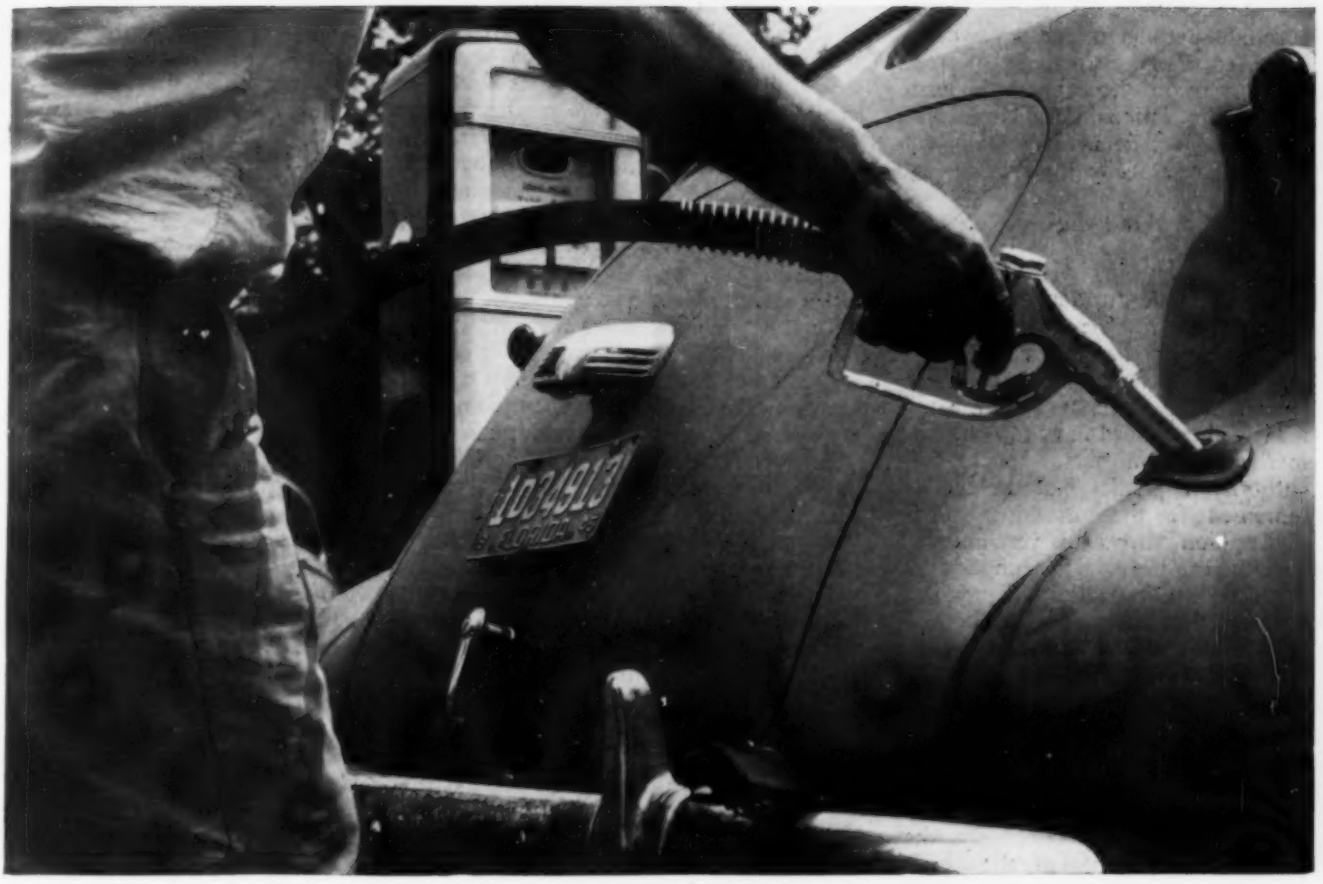
Chart for Belt Drive Selection

MYRON C. ZIEMKE
Oak Ridge, Tenn.

SINCE most a.c. motors are wound to operate at 1,750 rpm., the nomograph given here (based on that speed) is a handy method of determining pulley sizes to produce any desired speed of the driven machine. It is simply necessary to draw a line connecting two of the three quantities: motor pulley diameter, driven machine pulley diameter, and driven machine speed. For example, as shown on the chart, with a motor pulley of 2 in. diameter and a driven machine speed of 350 rpm., a driven machine pulley diameter of 10 in. is required.

Bag Storage Goes Overhead

Although this view happens to be in a food processing plant, the same principle can be used by chemical manufacturers having bag storage problems. This high-lift Yale & Towne platform truck elevates skid loads of 25 bags of sugar, each of 100 lb., for storage on an 8-ft. mezzanine level. Simply reversing the process enables the bags to be removed from storage and carried directly to the processing machines.



Synthetic Fuels

They'll be here—commercially—by 1950. First relief for hard-pressed petroleum will come from natural gas; two commercial plants are scheduled for completion within a year. Pilot plants are going full blast on other raw materials. From this flood of activity the editors of *Chem & Met* have tried to feel out the main currents: Who's doing what? How far have they gone? With what success?

Chem & Met REPORT

IN A VERY few years — perhaps late in 1949, surely in 1950—we are going to produce synthetic gasoline and heavier fuels from natural gas on a commercial scale for the first time in the United States. Some time within this period a plant will be operating in Pennsylvania which will go far in telling us the cost of getting these products by gasifying coal. This, also, will be a milestone in chemical engineering.

These developments follow years of research and result from two important facts: (1) our need for crude petroleum has begun to outstrip the known domestic reserves, (2) we have no assurance that we can continue to obtain sufficient supplies of foreign crude, particularly in the event of another war. We import foreign crude in record quantities today.

Many companies are spending millions of dollars annually today in research and development, their objective being to produce synthetic liquid fuels at the lowest possible cost. The Standard Oil Co. (New Jersey) is devoting about one-third of its research efforts to this field. Private industry is centering its work upon the production of fuels from synthesis gases derived from coal and natural gas as raw materials. The Bureau of Mines is working on these materials and also on the extraction and refining of shale oil and the hydrogenation of coal.

At present, the manufacture of synthetic liquid fuels by one or two processes, and under certain conditions, is probably competitive today with fuels from petroleum. Despite considerable conflict of estimates concerning this point, there is general agreement that synthetic fuels will have to be manufactured on a fairly large scale in the near future.

Demand for petroleum products in the United State is today without precedent, the war years not excepted. A Bureau of Mines forecast predicts

that during 1948, 5.3 million barrels of crude petroleum per day will be processed, a figure which outstrips all previous records (see chart, opposite page). The National Petroleum Council looks for a demand of about 6.0 million barrels daily by 1950.

Why the Furore?

We are burning petroleum at a record rate, and our demand is racing ahead of our reserves. More cars are on the highway than ever before. During the next few years many more engines using diesel fuel on the railroads will be placed in operation. The increase in farm tractors has led an authority to predict that the fuel requirement for these machines will be 100 million barrels this year and 110 million in 1949. Consumption of domestic heating oil is soaring; it is reported that whereas 2.5 million domestic burners were in use at the end of the war, 3.6 million were in use at the beginning of 1948, with a predicted 4.0 million in use during the coming winter.

We are not holding our own in such a race. The Oil and Gas Division of the Interior Department says that since 1942 the ratio of the known domestic reserves of crude petroleum at the beginning of each year to the total domestic demand during that year has been steadily dropping (see chart). Despite the fact that domestic crude reserves are increasing, these ratios are disturbing those who produce petroleum and those who are concerned with supplies in the future.

Imports of foreign crude are rising. In 1945 they averaged 203,700 bbl. per day; were 235,800 in 1946; 267,200 in 1947 and are predicted to reach 275,000 bbl. daily this year. E. V. Murphree, president of Standard Oil Development Co., doubts that proved reserves of domestic crude plus new discoveries and field extensions will be sufficient to meet domestic requirements for petroleum products. He concludes that this country will become increasingly dependent on imported oil. Few authorities are optimistic over our continued ability, in the present world crisis, to obtain sufficient foreign oil under any circumstance.

Fortunately, the United States has great known reserves of raw materials for synthetic liquid fuels to which industry and the government are turning. Natural gas reserves are considered to be around 170 trillion cubic feet. Coal reserves are placed at about 3 trillion tons. Although reserves of oil shale have not been fully explored, it is considered that in Colorado alone the shale worth working is equivalent to at least 100 billion barrels of crude shale oil. It is estimated that tar sands in California and Utah, and smaller amounts elsewhere, represent a potential gasoline volume of about 3 billion barrels. Agriculture residues are, of course, available; however, the problem of obtaining supplies in sufficient volumes at any given locality at reasonable cost works against the use of such materials at present.

Intensive work is under way. From the commercial standpoint the two pioneers are Stanolind Oil and Gas Co. and Carthage Hydrocol, Inc., the last-named being a group of companies headed by The Texas Co. Stanolind has begun to build near Garden City, Kan., a plant utilizing natural gas. At Brownsville, Tex., Carthage Hydrocol has been building a somewhat similar plant for over a year. At Library, Pa., Pittsburgh Consolidation Coal Co. and Standard Oil Development Co. are erecting a semi-commercial or large-scale pilot plant to produce synthesis gas from coal.

A number of the private companies, primarily in the oil refining industry, say little or nothing of what they are doing for competitive reasons. This is ample evidence that industry is confident of being able to improve the manufacture of synthetic fuels. It is at least one reason why private groups are opposing a grandiose government aspiration to spend hundreds of millions on large-scale commercial plants at a time when the technology of such fuels is progressing so rapidly that the plants might be technologically and economically obsolete by the time they could be completed. Authorities in the petroleum industry look for constant and swift improvements in the synthetic field in every way comparable to the improvements achieved in petroleum refining

Government is Active

To summarize briefly the government's role in the picture, the Interior Department got from Congress this year the authorization of another $30 million to continue investigations of synthetic liquid fuels initiated by the Bureau of Mines in 1944. The authorization would carry Mines' work to April 1952. That agency's latest big undertaking is the $4.5 million demonstration plant at Louisiana, Mo., for the production of fuels from the gasification of coal. The job, a large-scale pilot plant, has just been started.

On the basis of research and development perfomed thus far we have already made some notable improvements over the work done in Germany and elsewhere. Were it not so, the large synthesis plants at Brownsville and Garden City would hardly have been undertaken at this time. The application of the fluidized solids technique to the synthesis phase of liquid fuels manufacture is, of course, one of the outstanding achievements and has made it possible to reduce both investment costs and operating costs.

The German practice of performing the synthesis reaction in a number of small, fixed bed reactors necessitated a very large cooling area to carry off the heat of reaction. This costly system has been outmoded. The use of a fluidized catalyst has brought about significant simplifications in engineering design, high heat transfer rates and a reduction in plant investment, as well as much better control of temperatures. With respect to application of the fluid principles to the processing of solid raw materials, the experimental shale retorting plant being built at Baton Rouge for the Esso Laboratories and the coal gasification plant which Standard Oil Development Co. and Pittsburgh Consolidation Coal Co. are erecting at Library, Pa., are expected by company engineers to show marked advantages over fixed bed operation.

Other technological improvements include the use of a relatively inexpensive iron catalyst which results in synthetic gasoline having a much higher octane number than the German product, the development of fairly low cost oxygen and the generation of synthesis gases from natural gas at reactor pressure, reducing compression requirements to one-half that needed if the synthesis gas is generated at atmospheric pressure.

In view of the swift pace at which synthetic liquid fuels technology is moving, the question of how rapidly the productive capacity for manufacturing such fuels should be expanded is a serious problem. Private industry can hardly be expected to rush into large commercial ventures at a period of high construction costs and before the results of the significant projects at Brownsville, Garden City, and Library are available.

As for the program of large-scale government-sponsored plants which the Interior Department has been spearheading, it too faces the same issue. Opponents of the program who oppose it on technological grounds question the wisdom of a federal appropriation of $400 million to build plants to hydrogenate coal, produce synthetic fuels from coal and from shale, each with a capacity of 10,000 bbl. per day, when the Bureau of Mines itself says another $30 million

in further small-scale experimentation is necessary.

A. L. Solliday, executive vice president of Stanolind, says that private industry can do the job. Solliday told the Midcontinent Division, API, at Wichita, Kans., in March that "it is my feeling that government funds would not wisely be spent in building commercial-scale demonstration plants to prove the synthesis process when the two commercial plants now building are based upon engineering far ahead of that possessed by the Interior Department. At least three major oil companies are cooperating with the coal industry, or with other research organizations, in the development of a process for obtaining liquid fuels from the coal. Based on the past performance of the refining industry, with its millions currently being spent on research, and with its thousands of engineers and scientists with a long background of practical training and experience, it is reasonable to predict that the objective of more liquid fuel will be attained by the petroleum industry."

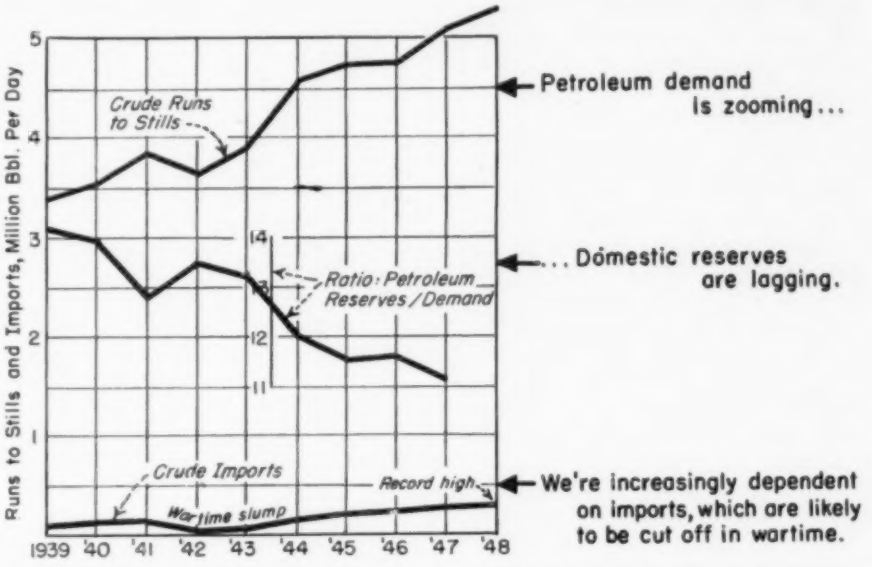
Proponents of a system of large government-financed plants contend that construction should be started soon because of our increasing dependence on foreign crude, because the task is too large to be deferred until after an emergency, and because private industry may be reluctant to install a large productive capacity at present. Each of these arguments has merit. Investments for national security seldom can be measured with the yardstick of economy, a point which advocates of government plants emphasize.

Against such contentions, however, several authorities in the petroleum industry have raised a cogent point. Great tonnages of steel are needed to expand the already functioning petroleum industry; until petroleum plant needs are better satisfied the steel should not be syphoned off for synthetic plants of uncertain performance.

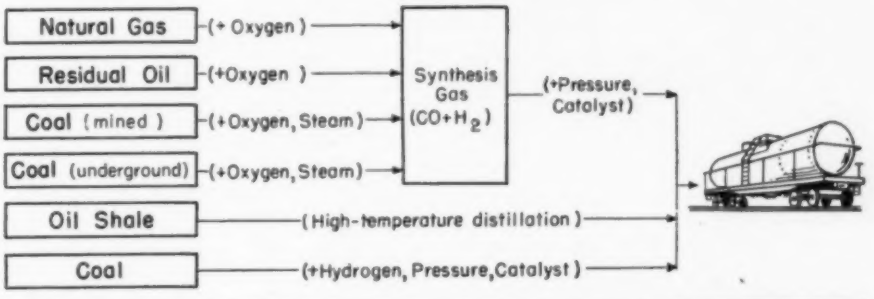
Reserves Not Unlimited

Another angle to the question of how rapidly productive capacity for synthetic fuels can be or should be expanded concerns the issues of raw material supply and water supply. Speaking for the moment about natural gas as a raw material, the fact that this country has around 170 trillion cubic feet of apparent reserves obviously doesn't mean that all or the greater part of this is likely to become gasoline and diesel fuels. Increasingly heavy drafts on gas reserves are being made for industrial and domestic heat-

THE NEED for synthetic fuels: Petroleum is not enough.



THE PROCESSES for synthetic fuels: Emphasis is on these six.



THE COST of synthetic fuels: So far only gas competes.

Comparative Costs for Gasoline From Various Sources (Est.)

	Crude Oil	Natural Gas	Coal*	Oil Shale
Investments				
For max. distillate yield, $/bbl./day oil products	4,300	7,400	7,600	6,100
For max. gasoline yield, $/bbl./day gasoline	6,500	8,200	8,500	8,400
Possible housing investment, $/bbl./day gasoline (max. gasoline case)	.....	.....	2,900	900
Steel requirements				
For max. distillate yield, tons/bbl./day oil products	5.7	7.1	4.6	5.7
For max. gasoline yield, tons/bbl./day gasoline	7.8	7.9	5.2	7.4
Percent gasoline in liquid products (max. gasoline case)	87	90	89	87
Raw material price assumed or est	$2.78/bbl.**	10c./MCF**	$3.20/ton	$1/ton
Gasoline costs (max. gasoline case)				
Raw material, c./gal	8.8**	2.9**	3.9	4.2
Mfg. less credits, c./gal	4.3	8.9	12.7	11.8
Product transp., c./gal	1.0	1.0	....	....
Total, c./gal	14.1**	12.8**	16.6	16.0
Added housing cost if required	.....	.....	1.9	0.6
Effect of increase in raw material cost	$1/bbl. adds 3.2c./gal.	10c./MCF adds 2.9c./gal.	$1/ton adds 1.2c./gal.	$1/ton adds 4.2c./gal.
Effect of 10 percent return on investment in mfg	1.6c./gal.	3.7c./gal.	....	....
or, mfg. plus mining	.....	.....	5.6c./gal.	5.5c./gal.

*In the East, by gasification. **These figures are based on crude oil and natural gas prices, not on their costs.

Data: Statement by E. V. Murphree, Standard Oil Development Co., to Oil Subcommittee of House Armed Service Committee, Feb. 25, 1948.

ing, and these claims have to be considered.

Gas fields of the magnitude required to service a commercial natural gas synthesis plant are not found all over the country. Many such fields, as in Texas and Louisiana, are already supplying existing large consumers. A plant of this type is a costly affair—the Carthage Hydrocol unit at Brownsville may run to over $20 million—and must have a fairly cheap gas supply sufficient to operate for something like a generation. Gas, if transmitted considerable distances from a number of small fields at a transmission cost of 1.5 to 2.0 c. per 1,000 cu. ft. per 100 mi., runs into money when consumed at the rate of 100 million cu. ft. per day, which is about the volume the Carthage Hydrocol unit will use.

The problem of gas supply for plants of this type has been considered by W. C. Schroeder, Bureau of Mines. Schroeder points out that a plant consuming 120 million feet of gas daily requires, over a 25-yr. period of operation, around a trillion feet. Schroeder says the number of locations capable of supplying gas on such a scale is limited, and thinks it likely that only a few plants using 100 million feet per day of gas could be located in Kansas, where the reserve is about 14 trillion feet.

Stanolind's A. L. Solliday says there are only a few gas reserves not already devoted to other uses, and considers that perhaps only about 20 plants, with a total liquid fuel production of 150,000 bbl. per day, will be built.

Pinched for Water

A possible limitation on synthesis plants consuming either natural gas or coal is water supply. The Stanolind plant at Garden City is expected to require 250 million gallons of water per day, including water for the chemical plant area. This is equivalent to the water requirements of a city of perhaps a million population. By using cooling and water recirculation the Stanolind requirement for makeup water will be about 10 million gallons daily. To reduce the net water duty even to this point, however, it will be necessary to erect the largest cooling tower in the world, a costly investment.

Water required for synthesis plants using coal is comparable to water requirements of the natural gas plants. A Bureau of Mines estimate assumes that from 10 to 15 million gallons of makeup water per day is needed for a coal-consuming plant having a capacity of 10,000 bbl. per day of liquid fuels. Water for a coal hydrogenation plant would be of the same order of magnitude, according to another Bureau of Mines estimate, which places the makeup water requirement at about 30 million gallons daily for a plant with a capacity of 30,000 bbl. per day of fuels.

E. V. Murphree mentioned the water factor last February when he told the House Armed Services Committee that much of our coal is west of the Mississippi in regions where water supply will be a pressing problem. He added that the question of water supply and other factors will have to be carefully analyzed before an estimate can be made of the volume of synthetic fuels to be expected from coal.

Even now, several fast-developing vicinities of the Gulf Coast are harassed by the lack of sufficient water for industries already existing there. It is the Gulf Coast region, incidentally, which boasts our largest stock of natural gas reserves.

Mercurial Economics

If we had a body of definite information about the relative investments and manufacturing costs, now and in the near future, for the different synthetic liquid fuels processes, a great deal of night work going on in laboratories and engineering offices might be dispensed with. What we do have are estimates, some well informed, some questionable, which rest on a bewildering variety of research and development, a myriad of basic assumptions, a measure of guess work, and outcroppings of optimism. To complete the picture there is the likelihood that tomorrow's research will considerably modify today's convictions and suppositions.

When the big plants in Kansas and Texas go into production in a year or so, their results will constitute the acid test of well informed beliefs that synthesis gasoline from natural gas is already competitive with gasoline from conventional petroleum refining. Also, their operation will go far toward predicting the cost of gasoline from coal gasification, since the gas synthesis phase, the treating of the gasoline and heavier fuels, and the recovery of chemicals are similar in many respects no matter whether natural gas or coal is the starting point. Likewise, when the coal gasification plant at Library, Pa., gets lined out under the management of a group of competent technologists, that work will shed much light on the cost of generating synthesis gas from coal. This information will dovetail neatly into the results obtained at the plants in Kansas and Texas.

In the meantime we have to do our figuring on a surface of quicksilver. The variables shift about. Processes change frequently. Continually rising construction costs change investment estimates and likewise affect operating costs. With respect to a given process the investment per unit of capacity depends on the size of the plant. Furthermore, the location of the plant has its influence on the investment and operating costs.

Such qualifications were emphasized in remarks on investments and operating costs which E. V. Murphree made early this year before the House Armed Services Committee. Murphree's approximate estimates (see table) indicate that for plants designed for maximum gasoline yield, the investments per bbl. per day of gasoline are: gasoline from crude petroleum, $6,500; gasoline from natural gas, $8,200; gasoline from coal gasification, $8,500; gasoline from shale oil, $8,400.

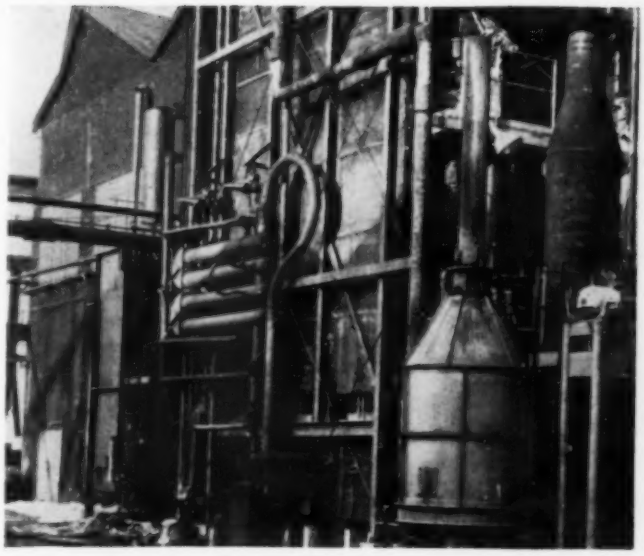
The daily capacities of the hypothetical plants involved here are: crude petroleum, 60,000 bbl. of crude; natural gas, 9,500 bbl. of total products; coal, 14,000 bbl. of total products; shale, 10,000 bbl. per day of raw shale oil. The investment figures would change if the sizes of the plants were changed appreciably.

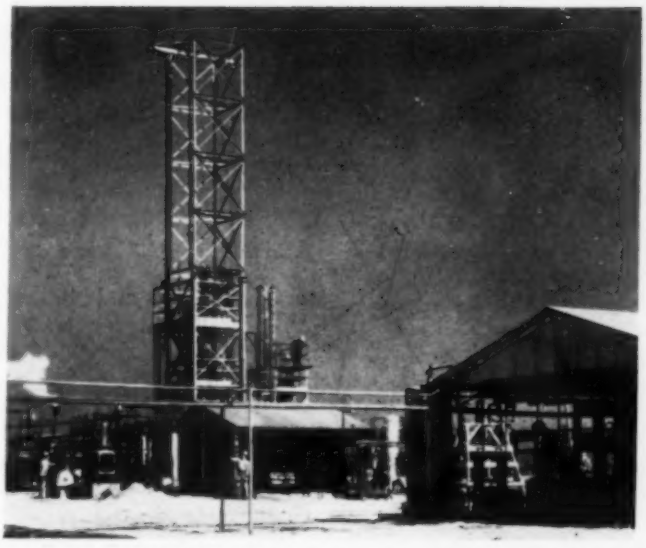
Murphree's figures for gasoline costs, as well as the investment data, contemplate a gasoline having a considerably higher octane number, and therefore more costly, than present premium grade fuel. He says, "it was felt that this quality gasoline may be required at the time there is any large production of synthetic gasoline since the use of such engines (10 to 1 compression ratio) is in itself an important conservation measure." The cost estimates include 5 percent for amortization and 10 percent return on total investments involved.

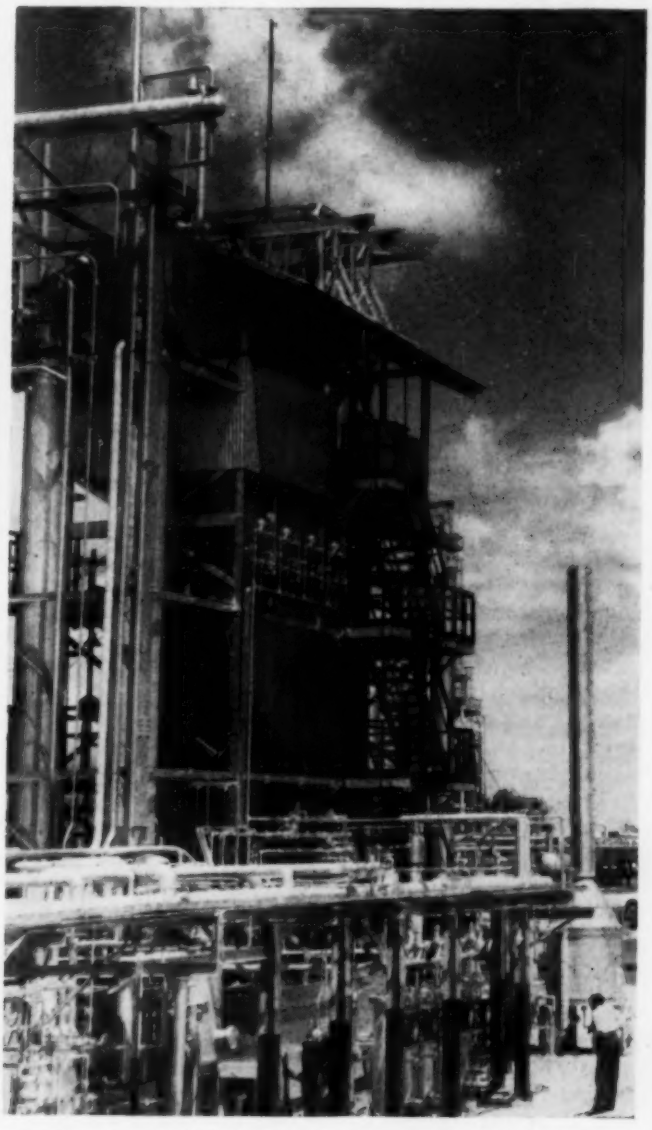
Based on natural gas priced at 10 c. per 1,000 cu. ft., gasoline from natural gas is figured at about a cent per gallon less than that from petroleum priced at $2.78 per bbl. Murphree, like many other authorities, looks for the price of gas to go up in the future. Counterbalancing this, however, is the probability that the price of crude, the value of which at the wells is now double what it was prewar, will also rise further, so that gasoline from natural gas evidently will stay in the competition.

Gasoline from coal gasification and from oil shale, at estimated costs of 16.6 c. and 16.0 c. respectively, are seen to be three or four cents higher

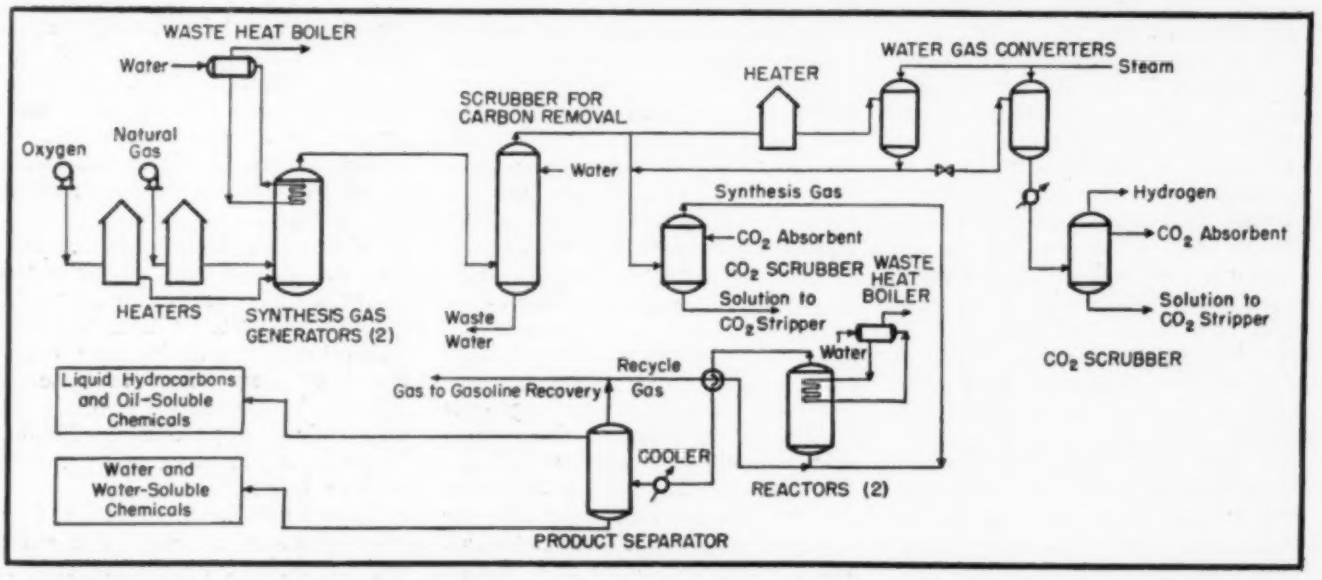
Natural gas is leading the race, but . . .





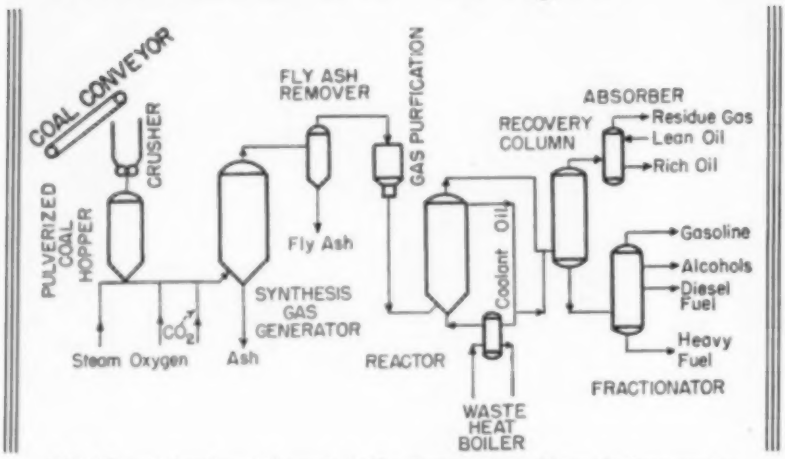


PILOT PLANTS like these have shown that synthesis from natural gas is practical. Among the many who paved the way: Kellogg, Newark, N. J. *(upper)*; Texaco, Montebello, Calif. *(lower)*; Cities Service, Lake Charles, La. *(right)*.

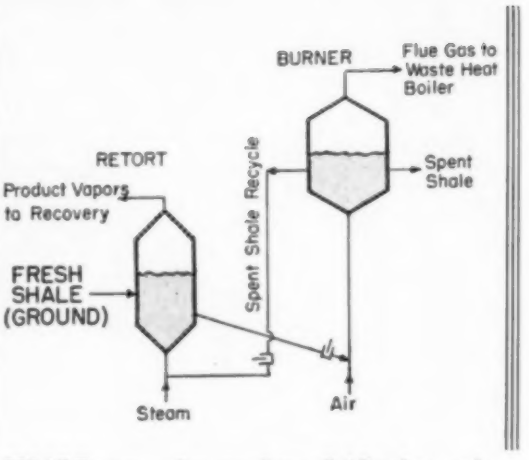


COMMERCIAL PLANTS are now going up at Garden City, Kan. (Stanolind) and Brownsville, Tex. (Carthage). This is how Stanolind will go from natural gas to synthesis gas to liquid fuel. Carthage process is essentially the same.

. . . Coal and shale are coming fast



COAL gasification (shown) looks better than direct hydrogenation. semi-commercial plant should be finished this year at Library, Pa.



SHALE got a leg up from fluidization and the new two vessel retort pictured here.

than the other gasolines. It is interesting to note that by far the greater part (about 75 percent) of the costs of the gasolines from coal and shale oil are expenses of manufacturing as distinct from cost of the coal and shale. This fact is significant. It gives hope to those who are working on methods expected to lower the manufacturing costs of the coal and shale processes. Even in the case of gasoline from natural gas the manufacturing cost item is seen to be 70 percent of the total cost.

These considerations all indicate that as technological improvements are made in the synthesis processes the gains will have a marked effect in reducing total costs. Improvements in the direction of lower investment requirements will necessarily be reflected in lower costs in view of the fact that these processes now call for very high investments.

Looking at gasoline costs as affected by what has to be paid for raw materials, Murphree's estimates show that gasoline from crude petroleum is markedly affected by the price of crude, which is seen to represent 62 percent of the total gasoline cost. The raw material prices assumed for the three other types of gasolines account in each case for roughly 25 percent of the gasoline costs. On the basis of Murphree's premises, an increase of one-fourth in the price of crude petroleum would mean an increase of 16 percent in the cost of gasoline from that material. On the other hand an increase of one-fourth for natural gas, coal and shale would increase the cost of gasolines from those materials by only 6 or 7 percent.

In other words gasoline from petroleum is much more susceptible than gasolines from the other materials to changes in raw material prices. Petroleum prices are on the way up. So are natural gas prices, but not at the pace of petroleum. It may reasonably be supposed that efforts now being made to reduce the costs of mining shale and coal will either reduce or at least stabilize those costs. Such considerations all promote competitiveness of synthetic liquid fuels which at present can't cope with petroleum gasoline.

Hydrogenation too Costly

Available evidence indicates that, economically, coal hydrogenation isn't in the picture at this time. A number of estimates agree that with respect to plant investment and operating costs this process is more expensive than the other processes for synthetic liquid fuels. It is significant that, as far as is known, only one private company is actively working on coal hydrogenation. All others are concentrating on the other synthesis processes. The Bureau of Mines believes that certain departures in design from the German hydrogenation practice which will be incorporated in the demonstration plant to be constructed this year at Louisiana, Mo., will result in better operating economies.

The Stanolind Plant

Nearest the stage of large-scale commercial operation is the production of liquid fuels from natural gas. Stanolind has disclosed a considerable amount of information concerning the commercial-scale synthesis plant which the company is building near Garden City to manufacture synthetic liquid fuels from natural gas. In view of the importance of this project, similar in some basic respects to the Carthage Hydrocol unit under construction at Brownsville, Tex., a description of the Garden City plant is outlined.

This unit will have a nominal capacity to produce daily approximately 5,000 bbl. of gasoline having an ASTM octane number (clear) of about 80, and 1,000 bbl. of total fuel oils. Between 300,000 and 400,000 lb. per day of oxygenated chemicals will be produced in the operation and subsequently separated.

Approximately 100 million cubic feet per day of dry natural gas containing 16 percent nitrogen will be charged to the plant, along with 53 million cubic feet per day of substantially pure oxygen manufactured by atmospheric liquefaction. Prior to entering the two synthesis gas generating vessels the natural gas and oxygen streams will be heated, respectively, to 1,200 deg. F. and 600 deg. F. (see flowsheet). Under a generator pressure of some 300 psi. and a temperature in excess of 2,400 deg. F., partial combustion of the natural gas results principally in carbon monoxide and hydrogen.

Destructively high metal temperatures are prevented in the generators by the use of refractory lining of the walls in the hottest zones. Much of the heat produced during the combustion is transferred from the gases to water tubes connected with waste heat boilers. Approximately 450,000 lb. per hr. of 675-lb. steam is produced in these boilers.

Gases leave the generators and receive additional cooling before entering a scrubbing tower for the removal, by a water stream, of any carbon present in the gas stream.

It is important that close control of the composition of the synthesis gas entering the reactors be maintained. Part of the gas mixture leaving the scrubber is passed through a preheater and raised to 600 to 700 deg. F., combined with steam and passed through a bed of iron catalyst where the reaction of carbon monoxide and steam produces carbon dioxide and hydrogen. An increase in the hydrogen content of the synthesis gases is thereby made possible. Gas from the converter is cooled and combined with the principal gas stream from the scrubber. The mixture then passes through a scrubber where carbon dioxide is removed by the amine absorption process. Synthesis gas moves from the top of the scrubber to the reactors.

A second catalytic converter is required in order to furnish hydrogen needed to reduce the iron catalyst used in the synthesis reactors. This converter takes a portion of the gas leaving the primary converter and, by the use of an excess of steam, reacts the carbon monoxide present to form carbon dioxide and hydrogen. Gas from this second converter is also passed through a scrubber for removal of carbon dioxide.

Two reactors, with a pressure range of 250 to 500 psi. and operating in the vicinity of 600 deg. F., are used. Synthesis gas, produced as outlined above, enters the bottoms of the reactors. Residue gas, a mixture of hydrogen, carbon monoxide, carbon dioxide and hydrcarbons remaining after liquid hydrocarbons and chemicals have been removed from the reactor effluent streams, can be recycled to enter the reactors with the incoming synthesis gas. This arrangement permits further control of the reaction.

The combined feed gases flow upward through the reactors and maintain the finely divided iron catalyst in a fluidized state. The use of catalyst in this condition, rather than in a fixed bed, results in high heat transfer rates to the boiler tubes in the reactors and permits close temperature control. Steam is produced at the rate of around 350,000 lb. per hr.

Effluent from the reactors passes through a system of heat exchange for cooling before entering the product separation area of the plant. In this area the effluent is split into three main parts: the liquid hydrocarbons and oil-soluble chemicals, water containing the water-soluble chemicals, and residue gas.

The liquid hydrocarbon stream and the solution of water-soluble chemicals are subsequently separated into the synthesis gasoline, fuel oils and chemicals. From the residue gas are recovered butylenes and propylene which are converted into conventional catalytic polymer gasoline.

Hydrocarbons produced in the reaction range from methane to the waxes, and are principally of the straight-chain variety. A large proportion consists of unsaturated compounds, a fact which accounts for the high octane rating of the synthesis gasoline.

Stanolind and Hydrocarbon Research, Inc., are handling the process engineering work for the project. The M. W. Kellogg Co. is building the synthesis unit proper. Foster-Wheeler Corp. is constructing the oxygen plant. Stone and Webster Engineering Corp. is erecting the power plant. E. B. Badger is contractor for the unit to handle the byproduct chemicals, which will be sold to U. S. Industrial Chemical Co.

The Carthage Plant

If current predictions of its sponsors prove correct, the first natural gas synthesis plant to go into operation will be completed by midyear 1949. This $20 million undertaking at Brownsville, Tex., is being erected on the lower Texas Gulf Coast by Carthage Hydrocol, a company owned by Forest Oil Corp., The Chicago Corp., LaGloria Corp., Niagara Share Corp., Stone and Webster, Inc., United Gas Corp., Western Natural Gas Co., Hydrocarbon Research, Inc., and The Texas Co.

Similar in basic respects to the Stanolind plant, this installation is rated at a capacity of 7,500 bbl. per day of liquid products, most of which will be gasoline. In addition to that product the plant is expected to produce daily 900 bbl. of gas oil, 200 bbl. of heavier fuel oil and 300,000 lb. of chemicals which will be separated near the plant. Arthur G. McKee & Co. is the general contractor for the plant, which is being designed by Hydrocarbon Research in collaboration with The Texas Co.

Raw material consumption will be at the daily rates of 90 million cubic feet of natural gas and 53 million cubic feet of oxygen. It is considered that by the use of low-cost steam generated in the synthesis gas generator and the reactor system, oxygen can be manufactured at a cost of around 5 c. per 1,000 cu. ft. Natural gas at a pressure of several hundred pounds will be piped from three or four fields at a distance of around 60 mi.

Like the Stanolind plant, the synthesis gases will be generated at pressures required in the reactor. This feature was worked out by The Texas Co. and Hydrocarbon Research.

Although it has not yet announced any plans for building a commercial natural gas synthesis plant, the Standard Oil Co. (New Jersey) group has been one of the outstanding contributors to much of the knowledge underlying the projects at Brownsville and Garden City. This organization has spent some $10 million in developing improved methods for manufacturing synthesis gas and synthesized products from both natural gas and coal. At Baton Rouge, the Esso Laboratories technologists are operating pilot plants with capacities up to 150 bbl. per day in the course of such work. A number of smaller pilot plants are in operation at Baton Rouge and Bayway.

Jersey's work in the field of fluidizing solids, first applied commercially in catalytic cracking, has helped much in overcoming the serious objections to the costly, inefficient German gas synthesis processes. Fluid-type reactors will be used in the two commercial natural gas synthesis plants under construction.

Another oil company actively interested in natural gas synthesis is The Texas Co. That organization is spending over $1 million a year in research and development on synthetic liquid fuels at its Beacon, N. Y., and Montebello, Calif., laboratories. At Beacon the company is doing fundamental work in such phases of the field as catalysts, equipment design and effects of operating variables. The company became active in the work around 1935 and made many studies of Fischer-Tropsch developments in Germany.

Full-System Pressure

At Montebello, where laboratories were established in 1945, the company determined in large-scale equipment that methane can be reacted with oxygen to produce synthesis gases at full-system pressure, that is, the pressure of the reactor. The Texas Co. at Montebello carried on investigations the results of which are incorporated in the design of the synthesis plants being built in Kansas and Texas.

The significant part which Hydrocarbon Research is playing in connection with synthetic fuels from natural gas has been referred to above. At present that organization is doing the process engineering work for a Hydrocol plant to be erected in South Africa by the Anglo-Transvaal Consolidated Investment Co. The plant will process soft coal. Present plans call for the production of 7,500 bbl.

per day of liquid fuels from 4,200 tons of coal daily. Construction will probably not begin this year.

At Olean, N. Y., Hydrocarbon Research developed on a pilot plant scale many process details being incorporated in the natural gas synthesis plant at Brownsville. The company concluded its first phase of research at Olean in 1946 and is now concentrating on research and development in its laboratories at Trenton, N. J.

The M. W. Kellogg Co., which grants licenses for the Synthol process, is another organization which has been for a number of years investigating synthetic fuels from natural gas as well as from other materials. Kellogg is testing a large body of information in new pilot plants at Jersey City, N. J., and Lake Charles, La. Company officials say that if their most recent data are further confirmed by pilot plant runs now being made, the company may announce in the near future an improved design for the synthesis of liquid fuels.

In addition to work of a process nature, Kellogg is engaged in studying the mechanical engineering features of processes for converting natural gas into liquid fuels and has worked out a method for the large-scale manufacture of oxygen of any desired purity.

Cities Service Co. disclosed early this year that it has been cooperating with The M. W. Kellogg Co. since 1946 in a program of synthesizing liquid fuels and byproduct chemicals from natural gas. The program, however, is broad. It involves much work on the handling of solids by the "fluid" process, including coal.

As early as 1926 Cities Service became interested in the direct oxidation of natural gas to produce chemicals and has spent millions of dollars since that time. The company's reserves of gas are among the largest in the country, one of the reasons for the firm's interest in synthesis processes.

Who's Who in Coal

With respect to the possibilities of coal as a source of synthesis gas the cooperative project which Pittsburgh Consolidation Coal Co. and Standard Oil Development Co. have undertaken at Library, Pa., is important. In the design of the large-scale pilot or semi-commercial plant under construction there the two companies have drawn on a fund of technological ability both within and outside their own groups and have the financial resources needed to sustain an exhaustive investigation. It is expected that a coal gasification plant of commercial size, including an installation to make synthetic liquid fuels from the gases, will follow.

The project at Library should go into operation toward the end of this year. An extensive experimental operating program is contemplated. This will include the preparation of coal and the charging of the material into the generators, a study of the effects of operating variables, and purification of the synthesis gases.

Underground Gasification Work

Another significant undertaking in connection with the gasification of coal is the work which the Alabama Power Co. is doing near Gorgas, Ala., in collaboration with the Bureau of Mines. This summer the company and the Bureau plan to carry forward on a wider scale the underground gasification work which was done in 1947 on a small scale under conditions which were unsatisfactory.

This year a much larger coal bed having an adequate cover will be used, a different system of starting and maintaining combustion will be employed and equipment to maintain an increased flow of air will be furnished. Under these conditions it is believed there is a much better chance to demonstrate that coal can be burned underground with controlled combustion to produce high Btu. gas for fuel purposes or synthesis gas.*

The Koppers Co. says it intends to spend substantial amounts of time and money this year in carrying forward investigations which it has made in the past in connection with the production of synthetic liquid fuels from coal.

The Texas Co. is interested in the gasification of coal at its Montebello, Calif., laboratories and is installing new equipment there.

Most phases of synthetic liquid fuels from coal are under study by the Bureau of Mines. Some time next year the Bureau hopes to put into operation at Louisiana, Mo., a demonstration plant to gasify coal and synthesize the gases. The project, for which Koppers has received the engineering and construction contract, is expected to have a capacity of about 80 bbl. per day of liquid products. In this $4.5 million job, pulverized coal will be combined with steam and oxygen to produce the synthesis gas. The synthesis step will be carried out in fixed-bed reactors where the heat will be removed by a high-boiling hydrocarbon oil in direct contact with the hot gases.

Also at Louisiana, Mo., the Bechtel Corp. is expected to complete this year for the Bureau of Mines the $7 million demonstration plant for the hydrogenation of coal.

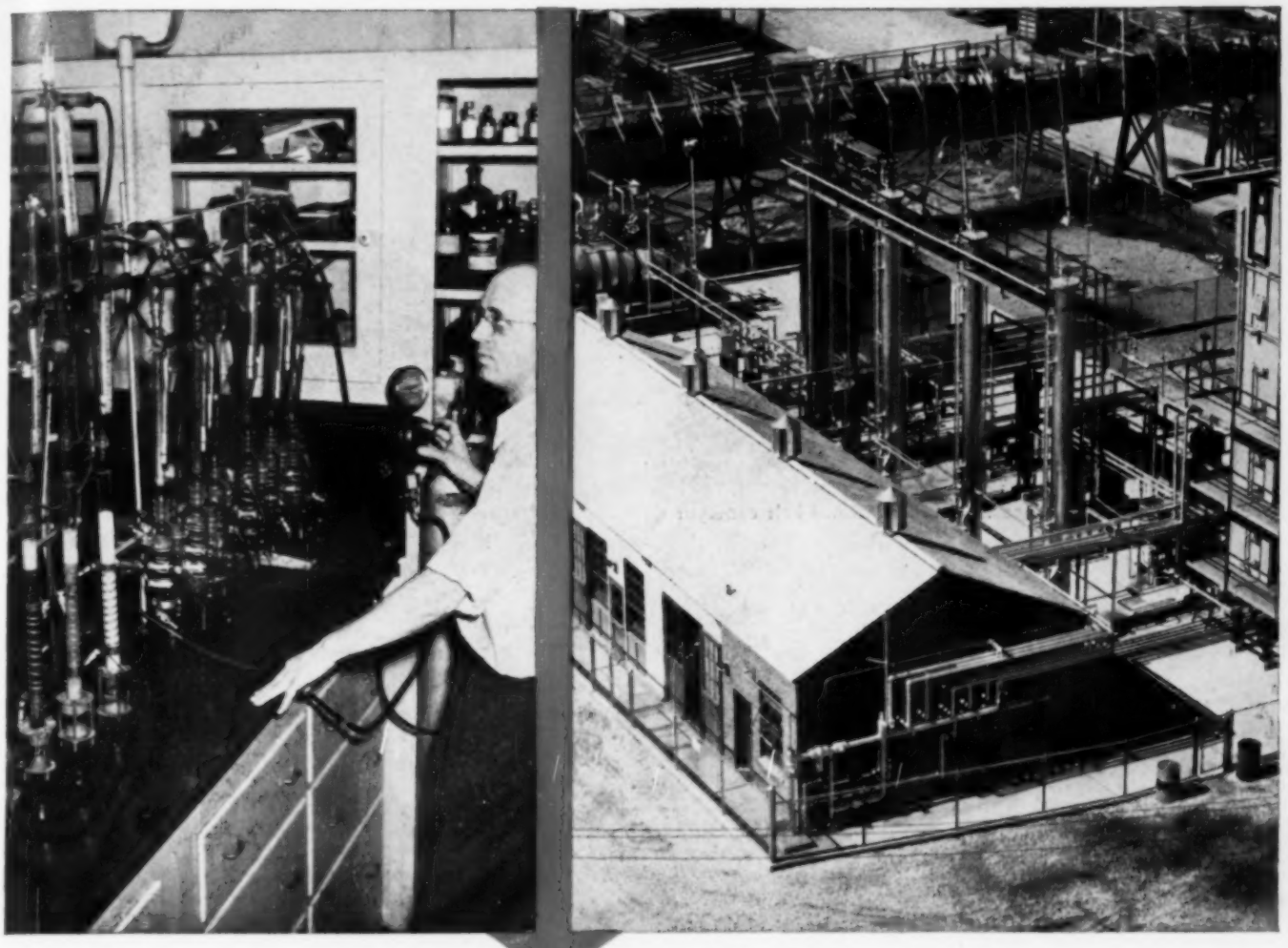
Capacity, depending on the type of operation used, will range from 200 to 400 bbl. per day of gasoline. The Bureau believes that a number of departures from German practice will improve the economic attractiveness of coal hydrogenation. Some of these differences are more efficient coal grinding and paste preparation, better heat economy, special valve design and flash distillation of heavy oil let-down.

At Pittsburgh and more recently at Bruceton, Pa., the Bureau of Mines has been continuing its laboratory and small-scale pilot plant studies of the hydrogenation and gasification of coal. The program for 1948 includes further development of the Vortex combustion chamber to generate synthesis gas, more work on the hydrogenation of dry coal (oil slurry not used) intended to reduce the investment required for a given capacity and to improve the heavy oil product, and additional work on a method developed to remove heat from the synthesis reaction by direct contacting of the synthesis gas with a hydrocarbon oil coolant. At Morgantown, W. Va., the Bureau is continuing its investigations in the purification of synthesis gas and is building a larger pilot plant, having a capacity of 200 lb. of coal per hr., to gasify powdered coal entrained in superheated steam and oxygen.

In its oil shale investigations the Bureau is hopeful of getting the oil refining end of its demonstration plant at Rifle, Colo., into operation this summer. The main feature of the refinery is a thermal cracking unit which will be operated in connection with facilities for treating the gasoline and fuels the refinery will produce.

The Bureau is testing several types of shale retorts this year, and will furnish shale for testing in a two-vessel retort (see drawing) being constructed in the Baton Rouge refinery of Esso Standard Oil Co. In this radical departure from fixed bed operation, crushed shale is kept in a fluidized condition by a small amount of steam. Heat is supplied to the retort by a stream of hot spent shale discharged into the retort from a second vessel where heat is generated by burning retorted shale which still retains some organic matter.

* Investigations of underground gasification of coal have been under way for some time, primarily in Russia. The Russians are known to have large-scale, commercial underground gasification in operation. One private company in the United States is also investigating the process on pilot scale in West Virginia.



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Girdler "know-how" will save time, trouble and money because all of the work is handled as one complete job.

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Gas Processes Division

DESIGNERS, ENGINEERS & CONSTRUCTORS

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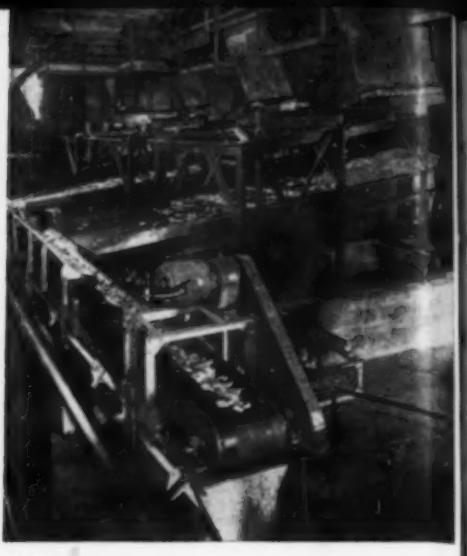
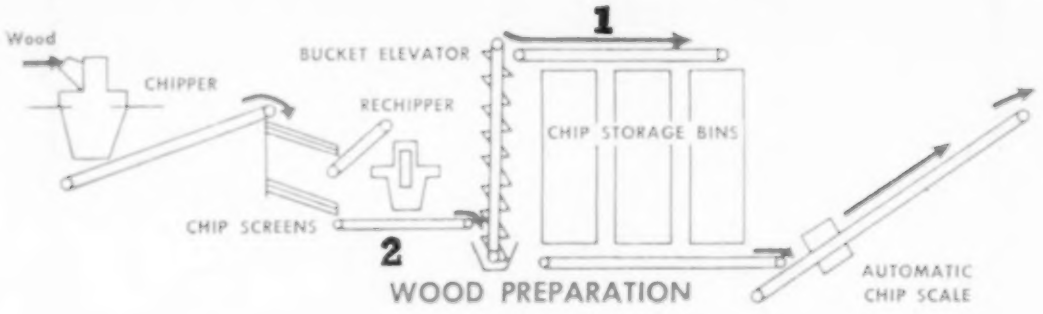
1 Sulphate pulping unit is major addition to the old mill. Chips from storage silos are charged direct to digesters via an inclined belt conveyor



2 Before going to storage, chips are screened; oversize chips are rechipped



Bleach Kraft Pulp

Article Page 123

When the Kalamazoo Vegetable Parchment Co., Parchment, Mich., purchased the Espanola, Ont., holdings of the Abitibi Power and Paper Co., Ltd., the main object was to establish its own source of bleached pulp. The abandoned newsprint mill was transformed to a modern bleached sulphate pulp mill as shown in this flowsheet. Not shown are the rebuilt paper machine, pulp refiners, groundwood mill, electrolytic chlorine cells and hydroelectric plant that help make the Espanola development a well rounded, integrated industry.

Basic raw material, wood, is received by water, rail or truck and is reduced to chips in the wood mill. Chips from storage pass through an automatic weighing unit on an inclined belt conveyor that discharges into any one of the five 9-ton digesters. After addition of white liquor (with an equal amount of black liquor to make up the total volume) the chips are cooked under pressure. An indirect heating system is used.

At the end of the cook (about 4 hr.) the discharge valve is opened and the pulp blown to the top of the blow tank. Pulp from the blow tank is screened to remove knots and is separated from the black liquor on rotary vacuum washers. It is then washed and passed through rifflers to remove sand or dirt and is screened before going to the screened stock storage tanks.

Screened pulp is then bleached in a six-stage batch-continuous system employing direct chlorination, calcium hypochlorite bleaching, and caustic extraction. First three stages and the fifth stage operate continuously at low density while the fourth and sixth stages are batch operations at high density. After each stage of bleaching the pulp is washed to remove dissolved impurities and coloring matter. Final bleached stock having a G.E. brightness of 80 is continuously formed into a sheet on a Kamyr machine and dried on steam heated dryer rolls. It is automatically cut into square sheets and baled.

Most important economy of the sulphate process comes from recovering chemicals for reuse. Black liquor from the washers is concentrated in a multiple effect evaporator unit, salt cake is added and the tarry material burned in a recovery furnace and waste heat boiler. Flue gas passes over the black liquor feed in a cascade evaporator and then through an electrostatic precipitator to recover entrained chemical dust. Molten inorganic chemicals collect in the bottom of the furnace and flow to a tank where they are dissolved to form green liquor. This is clarified and causticized with a mixture of recovered and make-up lime after which it is clarified to form white liquor ready for use in the digesters. Lime mud ($CaCO_3$) from the white liquor clarifier is washed and thickened on a rotary vacuum filter before it is calcined in a rotary kiln. Recovered lime is then stored for reuse.

CHEMICAL ENGINEERING

June, 1948

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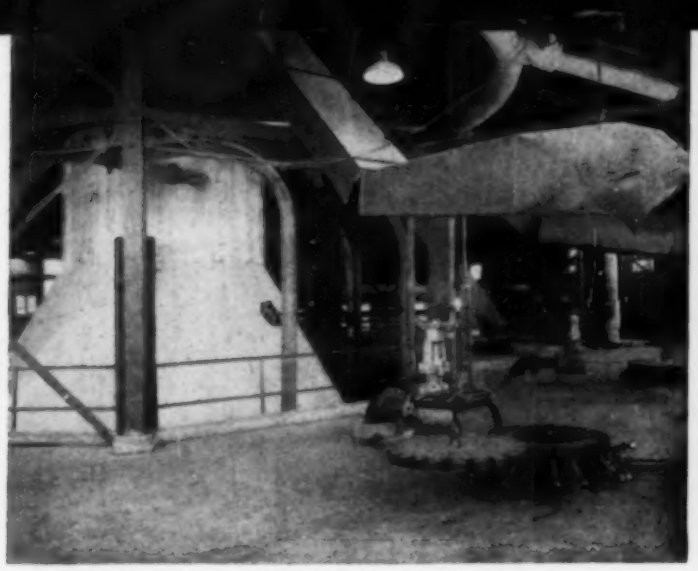
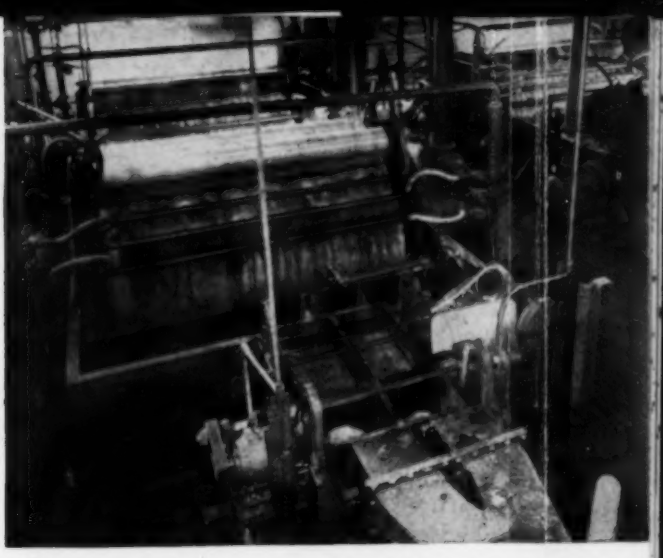
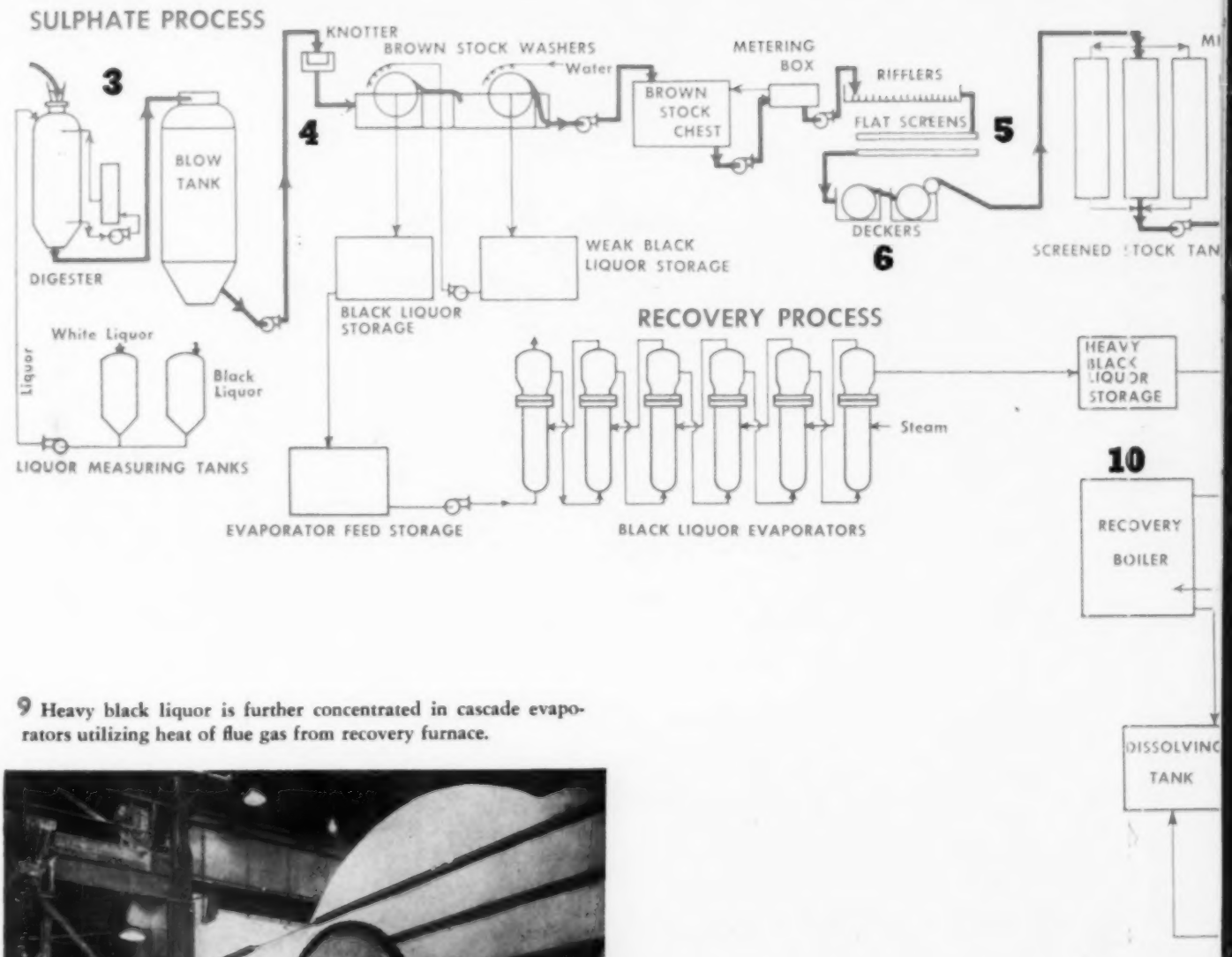


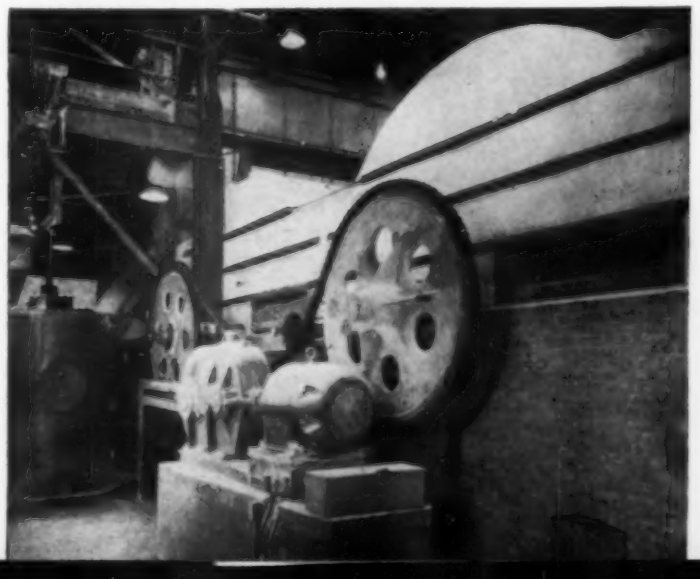
3 Indirect heated digesters arranged in a semicircle about the blow tank; operation is controlled from instrument panel.



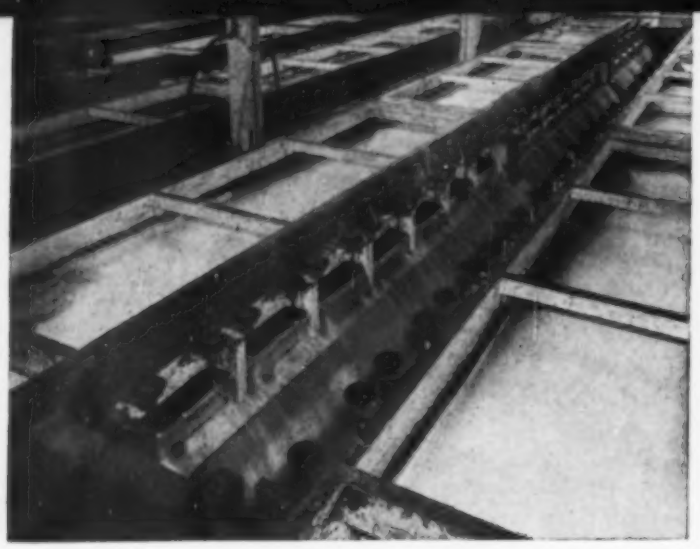
4 Knots and slivers are removed in the knotter (foreground) before the black stock goes to the rotary vacuum washers



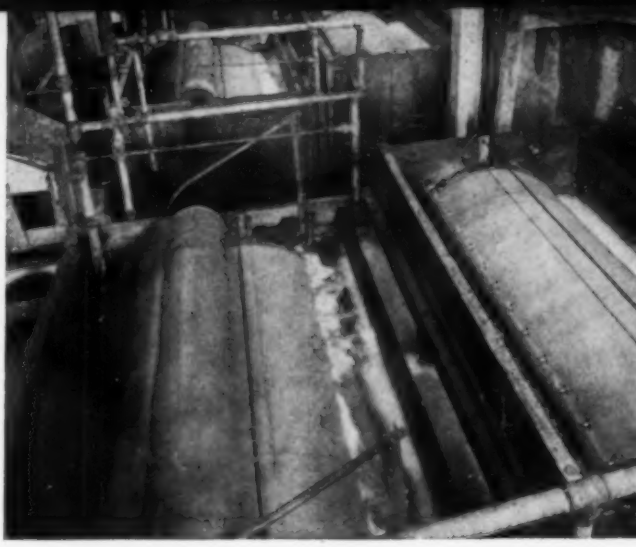
9 Heavy black liquor is further concentrated in cascade evaporators utilizing heat of flue gas from recovery furnace.



(foreground)
cuum washers.

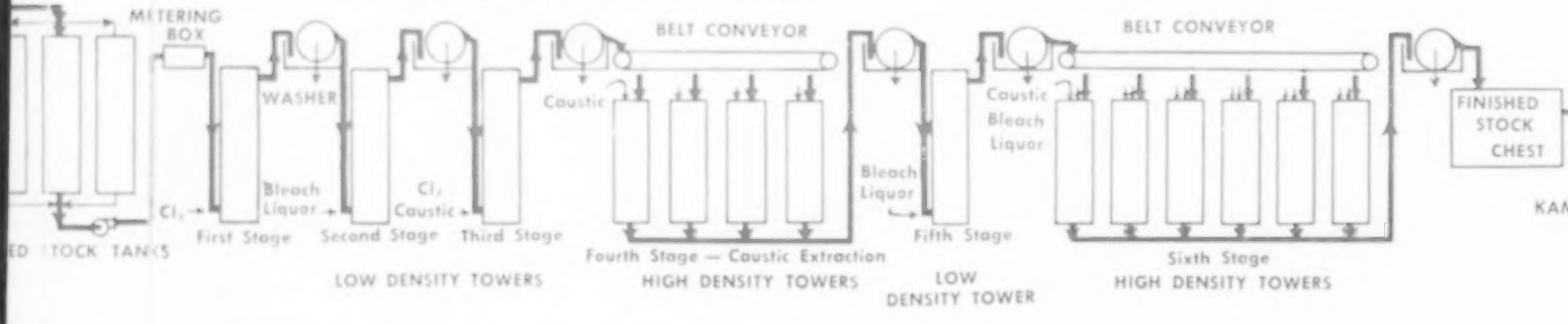


5 After washing, accepted stock passes through the flat screens while rejected stock is refined mechanically.

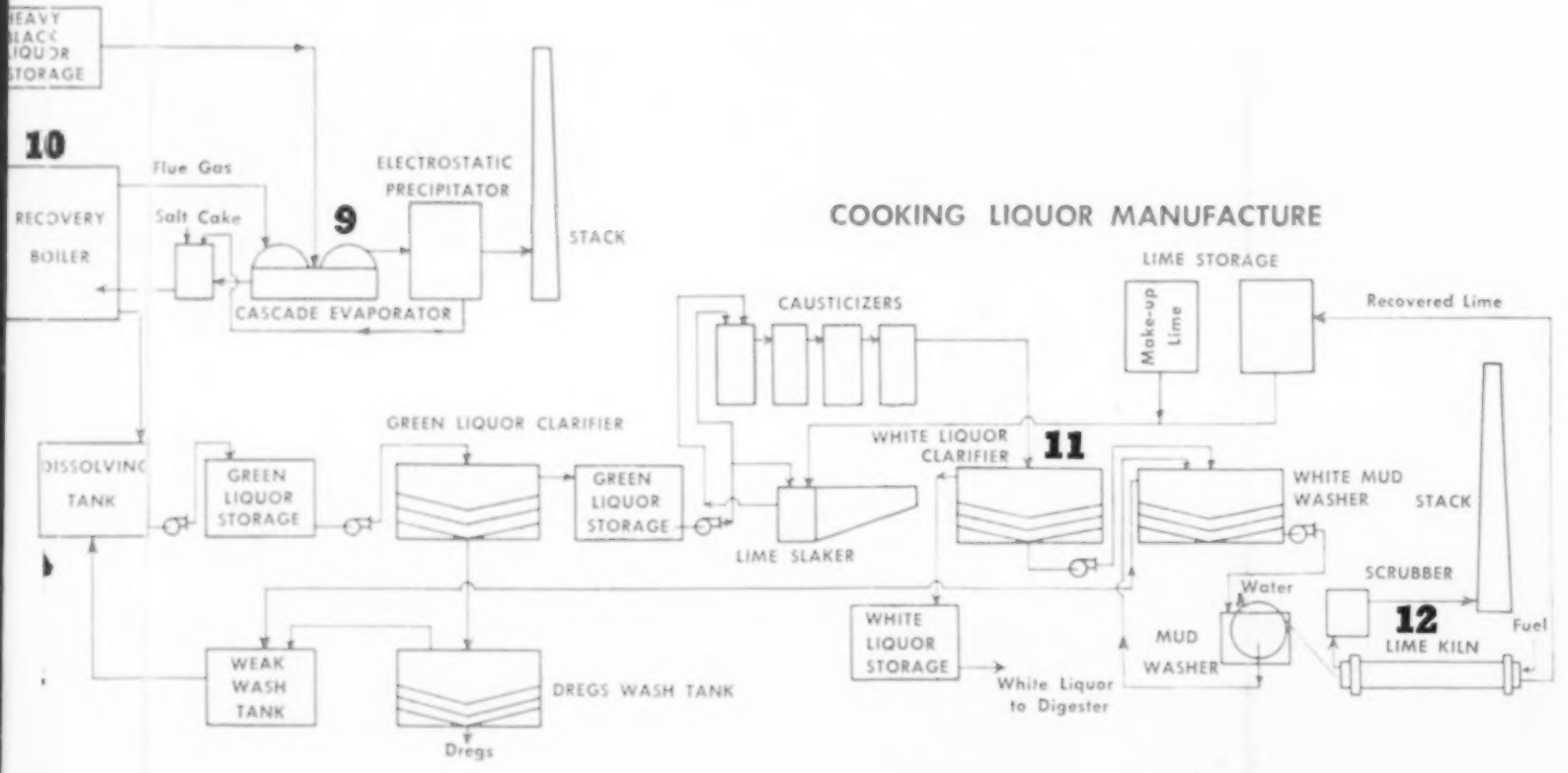


6 Ready for bleaching, the washed screened stock is dewater on thickeners or deckers. Whitewater is reused.

CONTINUOUS BLEACHING PROCESS

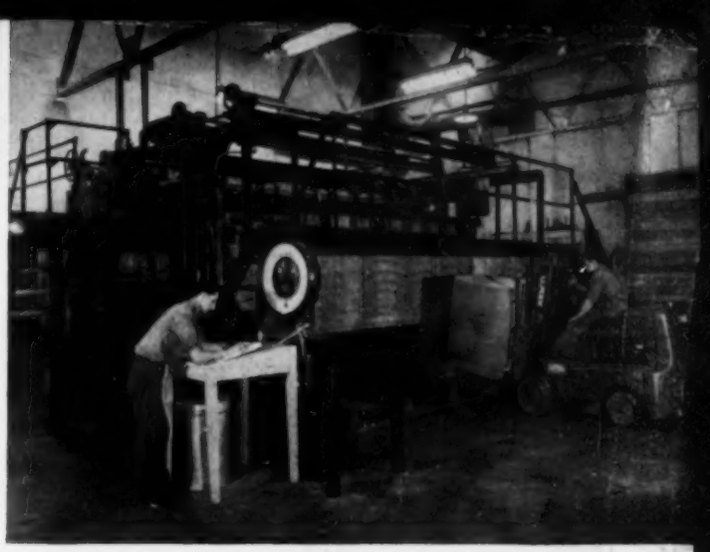


COOKING LIQUOR MANUFACTURE

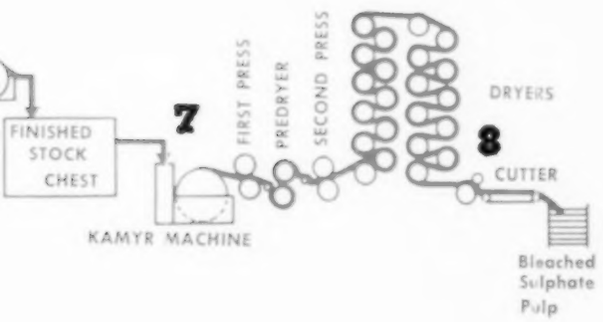


k is dewatered

7 Kamyr machine forms pulp into continuous sheet which passes through press rolls, predryer and double stack of dryer rolls.

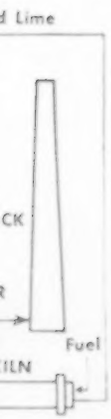


8 Dried pulp from the Kamyr is automatically cut, piled and then taken to the baling machine.

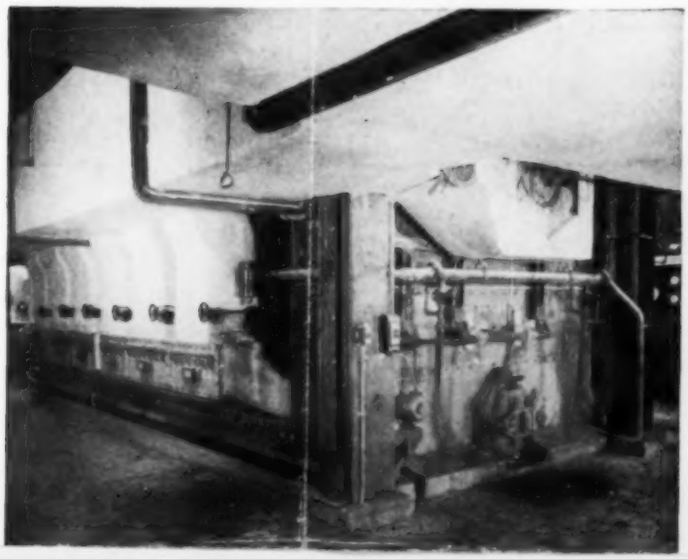


11 Green liquor is causticized with lime and the resulting slurry is passed through continuous clarifiers.

d Lime



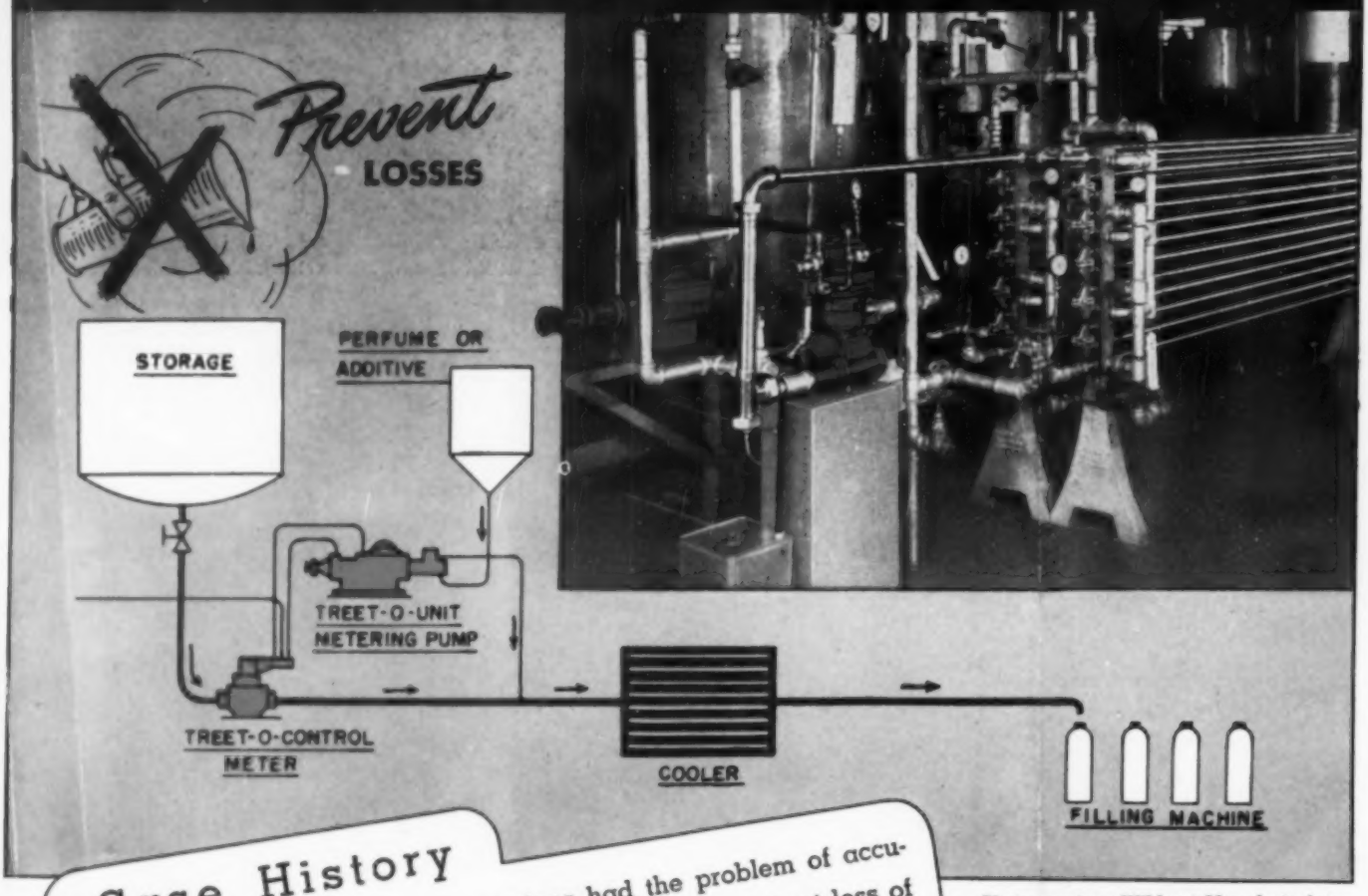
10 Organic material in the liquor is burned off in the recovery furnace and molten chemicals form green liquor in the dissolver.



12 Thickened lime mud is calcined in an oil fired rotary kiln and the burned lime returned to storage.

INJECT COSTLY ADDITIVES UNDER LINE PRESSURE

Simply-Efficiently-Accurately!



Case History

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Photo courtesy Wildroot Manufacturing Co., Buffalo, N. Y. All equipment shown red in photograph and flowgram furnished by %Proportioneers, Inc.%.

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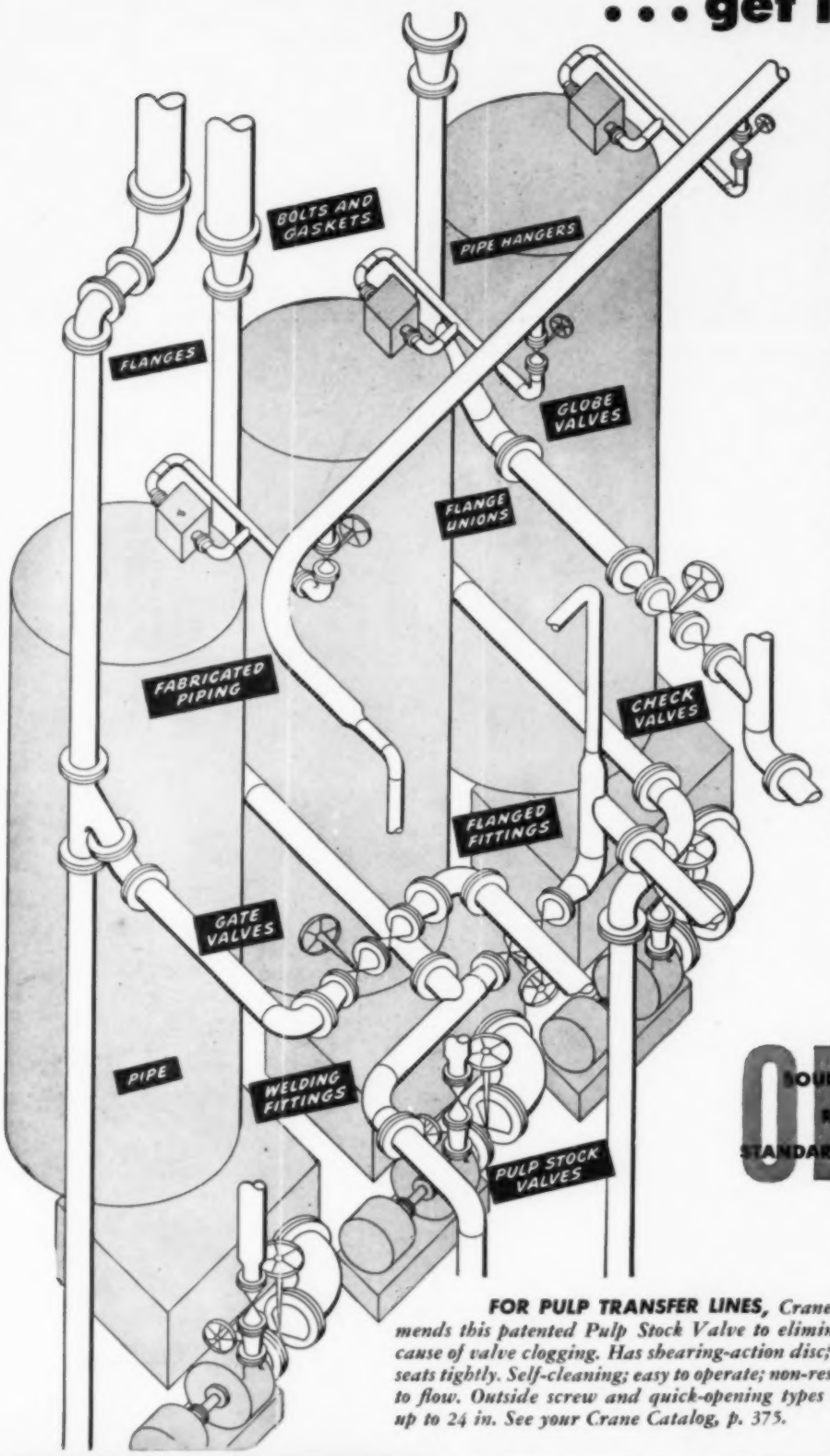

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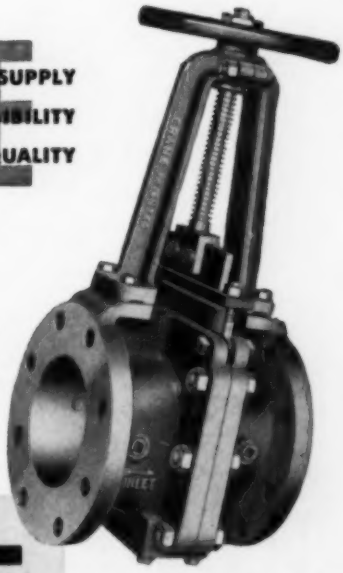

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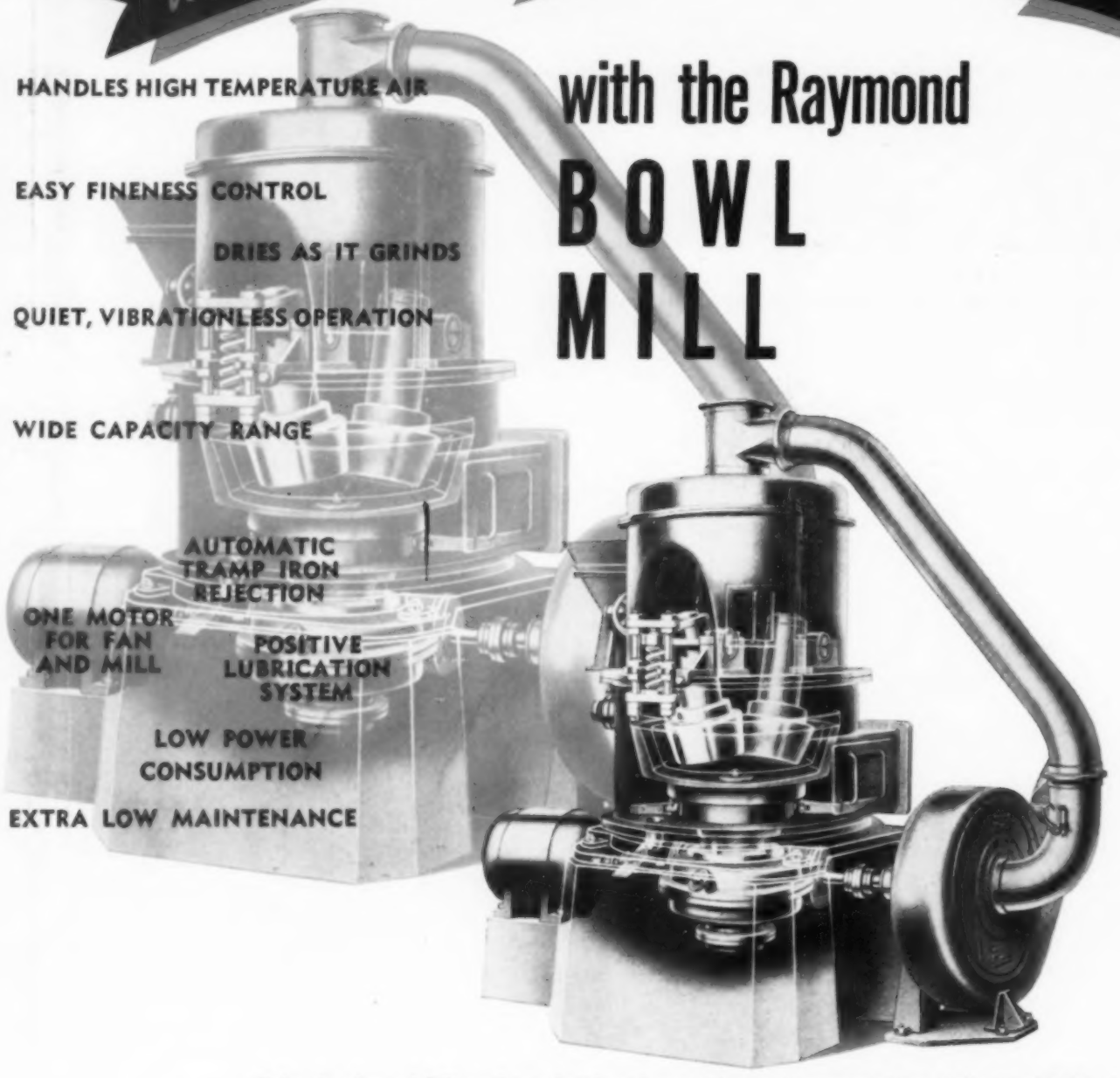

Take the dependability of powdered coal as a fuel, and add the dependability of the Bowl Mill as a grinding unit . . . and you have an unbeatable combination for insuring sustained economy for direct-firing rotary kilns and industrial furnaces.

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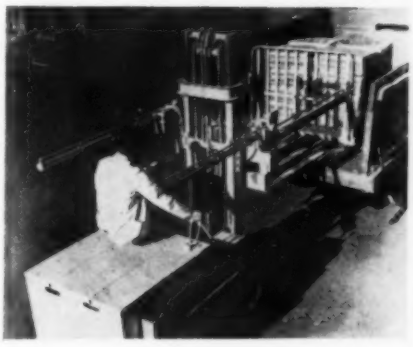
PROCESS EQUIPMENT NEWS

Theodore R. Olive, ASSOCIATE EDITOR



1. Load Pusher

To FACILITATE removing material from pallets, or directly from the forks of a fork truck, the Tructractor Division of Clark Equipment Co., Battle Creek, Mich., has introduced an improved hydraulic pusher device for use on fork trucks of its manufacture. The device permits the load to be removed as a unit, rather than piece-by-piece. The pusher rack travels horizontally and is connected to two hydraulic cylinders supported on horizontal slide channels mounted on roller bearings. Side guard members provide ample protection to the slides and cylinders. The standard, maximum forward travel of the pusher rack is 55½ in. Standard forks may be used when handling loads on pallets. Where loads are removed directly from the fork, multiple forks (usually five) are used.

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FOR MORE INFORMATION
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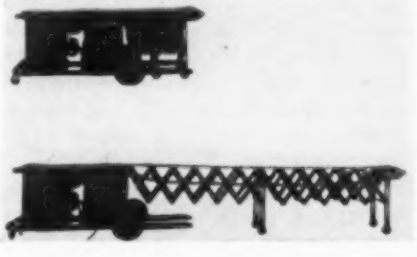
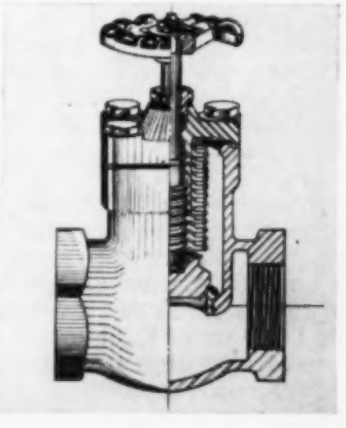


2. Extendable Conveyor

THROUGH use of a "Lazy-tongs" type of construction, the Standard Conveyor Co., of St. Paul 9, Minn., has developed the Extend-O-Veyor, a conveyor of adjustable length for handling sacks, cartons, etc., over any horizontal distance up to 46 ft. in either direction. The construction illustrated in the accompanying view permits extension or retraction to any length between a maximum and minimum. The conveyor may be moved to the point of use and put into immediate action without bothering about slope, or coupling sections together. Since the extendable parts pivot at each support, declines or inclines are permitted.

3. Orifice Rotameter

ACCORDING to an announcement from Fischer & Porter Co., Hatboro, Pa., this concern is now prepared to supply its Flowrator rotameters for bypass service in larger pipelines. An orifice is installed in the pipeline and the flowmeter in a bypass line around the orifice so as to measure a fixed proportion of the total flow. As compared with other types of orifice meter, this method offers the advantages of requiring no seal pots, no equalizing valves, linear scale calibration and no special manometer fluid. The bypass lines are automatically purged and any corrosive fluids that can be handled by the line or meter can be measured. Exact calibration is obtained by inserting a small orifice in the inlet fitting of the flowmeter itself to assure precise proportionality between main line flow and bypass flow. But since the bypass flow varies directly as the main line flow, calibration of the flowmeter is not affected. The method enables any type of Flowrator to be employed.



4. Packless Valve

ELIMINATION of the maintenance required with stuffing boxes, together with complete prevention of leakage,

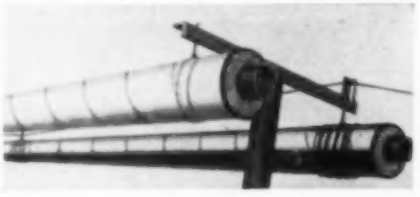
are features of a new line of packless valves introduced by the Packless Valve Dept., Fulton Sylphon Division of Robertshaw-Fulton Controls Co., Knoxville, Tenn. Designated as the 3000 Series, the new valve employs a seamless metal bellows to form a leakless connection between the valve disk and the body. Such valves are produced with stainless steel bellows and stainless steel bodies. However, the bodies are also available in bronze, cast iron, cast steel or Monel metal, while the Sylphon bellows is produced also in Monel, phosphor bronze and brass. For high-vacuum service a composition disk is used instead of a metal disk. These valves are made in sizes from ¼ to 3 in. with screwed, welded or flanged ends. The type illustrated is suitable for temperatures to 300 deg. F. while a yoke and external thread construction is employed for 700 deg. F. operation, and special construction for extreme temperatures up to 1,200 deg. F.

5. Portable Leak Detector

DESIGNED for the production testing of hermetically sealed equipment containing halogen compounds, such as refrigerants, or for locating leaks in tanks, boilers and piping into which a tracer halogen compound can be introduced, a new portable leak detector is being offered by the Special Products Division, of General Electric Co., Schenectady, N. Y. As the accompanying illustration shows, the instrument consists of a hand-held probe detector unit and a control unit equipped with a carrying strap. The instrument is sensitive enough to detect a leak so small that it will release only 1/100 oz. of Freon in one year. Seams can be inspected at the rate of about ¼ in. per sec. The detector unit contains a sensitive element responsive to halogens in the air, and a motor-driven blower to circulate air through the sensitive element. The control unit contains the power supply, amplifier, indicating instrument, necessary controls, and is supplied from any standard power circuit through a 25 ft. lead.

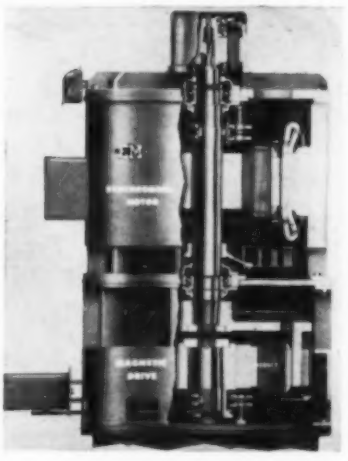
6. Agitated Reactor

BUILT to ASME code standards in a variety of weldable construction materials, a new agitated reactor, known as the "Standard-Plus," has been announced by Industrial Process Engineers, 5200 Hudson Ave., West New York, N. J. This reactor is designed for processing needs in synthetic detergents, insecticides, synthetic organic chemicals, resins, varnishes, adhesives, glue, gelatine, pharmaceuticals, fine chemicals, cellulose products, coal tar products, fertilizers, explosives, dyes, intermediates, and a variety of other products. All necessary equipment is included for any particular requirement. Heating may be by direct or indirect methods, the latter including steam or Dowtherm, and the former either direct firing or electricity. A variety of agitator types are supplied, depending on needs, with variable speed drive if required. The reactor shown is one of 2,000 gal. capacity for the esterification of sorbitol. It is heated by Dowtherm vapor at 75 psi., and is designed for 100 psi. internal working pressure and full vacuum.



7. Foil-Clad Pipe

PROTECTION of insulation from the weather is afforded by a new method of foil-covering offered by the Ric-Wil Co., Cleveland, Ohio. Pipe so insulated and protected is shipped completely prefabricated from the manufacturer, ready for installation, with only one handling required at the job site. Foil-clad units are shipped in 21-ft. sections, employing asbestos, cork or other insulation, as specified, which is machine-coated with high temperature asphalt, and tension-wrapped with asphalt-saturated asbestos felt. A second coating of asphalt is followed by a tension-wrapping of aluminum or copper foil to produce a unit said to be completely waterproof and weather-protected. Similar units are available with a double-concentric pipe within the insulation for handling two fluids, or a process fluid and a heating or cooling fluid.



8. Vertical Pump Drive

FOR THE variable speed driving of vertical centrifugal pumps, Electric Machinery Mfg. Co., Minneapolis 13, Minn., has announced a vertical synchronous motor magnetic drive unit, capable of giving smooth, adjustable speed control for such pumps. The motor drives the ring of a magnetic drive at constant speed. The magnet member of the magnetic drive mounted on the gear shaft operates the pump at whatever speed is required by the liquid level control mechanism used. The design is said to preclude hunting and to eliminate frequent motor starts and stops. The accompanying cut-away view shows a 250 hp., 1,200 rpm. drive which operates a 200 rpm. vertical sewage pump through a reduction gear.

9. Pulp Disintegrator

A NEW MACHINE for the rapid disintegration of paper pulp and waste paper, for which further applications are anticipated in the chemical field, has been developed by E. D. Jones & Sons Co., Pittsfield, Mass. Known as the Pulpmaster, this machine consists of a vertical cylindrical tank with a

How to get

THE MOST OUT OF YOUR STAINLESS STEEL EQUIPMENT

★ Getting the *best process results* along with the *longest service life* with stainless steel equipment involves more than a superficial knowledge of engineering and metallurgy.

That's why so many important companies call on Pfaudler for custom-built as well as standard stainless steel equipment. They know they can depend on Pfaudler engineering to develop the process, if necessary, but, in any case, to interpret requirements correctly at reasonable cost. They know Pfaudler controls quality from raw material to finished equipment. They know Pfaudler has *complete facilities to* do each job right, including heat treatment and passivation.

This kind of know-how is the accumulation of 65 years of service to the process industries. Take advantage of it on your next stainless steel requirement—you will get more out of *your* expenditure. Your inquiries are invited.

PROCESSING IN THE ABSENCE OF METAL

Processes which do not permit the tolerance of metal in solution can be safely handled in Pfaudler glass-lined steel equipment. It is resistant to all acids, except hydrofluoric and commercial phosphoric.

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Branch Offices: 330 West 42nd St., New York 18, N. Y.; 111 W. Washington Ave., Chicago 2, Ill.; 1325 Howard St., San Francisco 3, Calif.; 818 Olive St., St. Louis 1, Mo.; 63 West Milwaukee Ave., Detroit 2, Mich.; 1318 1st Nat'l Bank Bldg., Cincinnati 2, O.; 1041 Commercial Trs. Bldg., Philadelphia 2, Pa.; 751 Little Bldg., Boston 16, Mass.; 334 Chattanooga Bank Bldg., Chattanooga, Tenn.; Enamelled Metal Products Corp., Ltd., Artillery House, Artillery Row, London, S. W. 1, England.

THE PFAUDLER CO., ROCHESTER 4, NEW YORK

ENGINEERS AND FABRICATORS OF CORROSION RESISTANT PROCESS EQUIPMENT

Glass-Lined Steel . . . Stainless Steels . . . Nickel . . . Inconel . . . Monel Metal

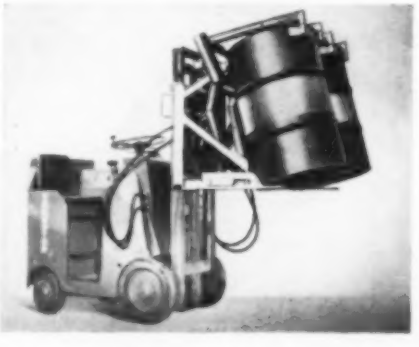
conical bottom, containing a specially designed agitating and disintegrating apparatus mounted on a horizontal shaft at a point about halfway up the tank. The agitating device, which is driven at 185 rpm., is a one-piece fabricated construction made up of two truncated eight-sided pyramids with the small ends placed together and each face equipped with an agitating bar placed across the diagonals. At each end of the rotor are collector vanes and curve-bladed impellers. The latter rotate in front of stationary refining disks. The effect of this assembly is first to break the material down into smaller pieces which are then forced toward the ends of the rotor and driven by the impellers into rubbing contact with the stationary disks. It is claimed that a ton of pulp can be reduced in ten minutes with 100-150 hp. and that waste paper requires about four times as long.

10. Pinch Valve

FIELD TESTS over a period of more than ten years have indicated exceptional life, it is claimed, for a new pinch valve now being offered by Farris Engineering Corp., 458 Commercial Ave., Palisades Park, N. J. One such valve, installed in 1939, is opened and closed every two minutes, seven hours a day, and is said still to be in service, without any breakdown or replacement. As the illustration shows, the valve consists of a special rubber tube with integral flanges, and a tube pinching mechanism for throttling or shutting off the flow. The tube, heart of the valve, employs an inside rubber tube and is fabricated by wrapping specially impregnated cloth around this tube, followed by layers of pure gum. The entire unit is wrapped in an acid-resisting covering and the flanges are built on during the construction of the wrapping. The entire unit is then vulcanized and cured. The over-all thickness is calculated to allow flexing without fatigue and breakdown. The valve may be closed tight against solids in suspension without damage, and if frozen may be opened simply by striking the valve with a mallet. Sizes are regularly available from 1 to 10 in., for working pressures to 100 lb. Other sizes can be secured from 12 to 96 in. diameter.

11. Mass Spectrometer

CAPABLE of measuring and recording over the mass range from 1 to 350, and adjustable to any portion of that range, a new mass spectrometer has been announced by the Special Products Division of General Electric Co., Schenectady, N. Y. The instrument is applicable to general chemical analysis and to isotope abundance measurements. It is built in two main units for easy inspection and maintenance, including a control unit containing the electronic components and recorder, and a tube rack housing the spectrometer tube, vacuum pumps, gages, sampling system and additional components.



12. Drum Carrier

DESIGNED for installation on any hydraulically-operated fork truck is the new Drum Master produced by William Ehlers, 408 South Spring St., Los Angeles, Calif. The device can be attached to the truck, or removed, in a matter of minutes to permit the truck to perform a dual role. It assures maximum flexibility by incorporating special chine clamps in addition to the regular tilting arms. In operations where the chine clamps alone will serve, the arms can be removed; if the arms are more suitable for the containers to be handled, the chine clamps may be lifted out of the way. Either method is at the immediate option of the operator and the device is said to be adaptable to handling all types and sizes of cylindrical containers including barrels, casks, hogsheads, kegs or drums. Containers can be picked up either singly or in pairs and can be handled either single-decked or tiered.

13. Safety Seat

FOR INDUSTRIAL maintenance, when a worker must be lowered into a stack or tank, Buckingham Mfg. Co., Binghamton, N. Y., has introduced a new safety seat with shoulder harness which, as the illustration shows, enables the worker to perform his duties with complete freedom, but holds him upright in the saddle if he should be overcome by fumes while working. Construction is such that the supporting cable can be slacked off when the worker is at the bottom of the tank to permit freedom of action without danger of any of the parts slipping out of place.

14. Evaporative Condenser

IMPROVEMENTS in its Aeropass evaporative condenser for refrigerant gases have been announced by the Niagara Blower Co., 405 Lexington Ave., New York 17, N. Y. The condensing is done by passing the gas through two coils in an air stream; first, a dry coil and an oil separator to remove superheat and oil vapor; then, through a wet coil which condenses the gas at low temperature. About 1,000 Btu. are removed for each pound of water evap-

No doubt, the steadily increasing good health of the American people is largely due to the extensive enrichment program of the food manufacturers. In the enrichment and production of many food products, Victor* Phosphates play important and varying roles. Cereals, flour, prepared mixes, and food beverages, for example, are enriched with essential calcium, phosphorus, and iron by the addition of Victor calcium and iron phosphates. Victor calcium phosphates are also used to provide the necessary leavening acid in prepared flour mixes.

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Sodium Acid Pyrophosphate . . . acid ingredient in commercial baking powders, prepared doughnut and cake flours.

Ammonium Phosphates . . . yeast, vinegar, yeast food.

Dicalcium Phosphate . . . mineral fortification.

Disodium Phosphate . . . process cheese, condensed milk.

Hicalcium Phosphate . . . calcium-enriched flour and bread.

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FOR MORE INFORMATION
See Reader Service Coupon on pages 163-164

orated, the spray water being recirculated with make-up provided only to offset evaporation.

In the new design the head pressure control method is affected. The interior of the casing is partitioned so that by operation of dampers either all fresh air or any degree of recirculation of air may be employed. This varies with the condensing load and with changes in air temperature according to the weather, so that the compressors are operated automatically at the desired head pressure which, in practice, is the minimum required properly to distribute the refrigerant. In the new design all dampers are located internally, protected from outside weather conditions. The unit eliminates need for manually operated control of compressors and condensers and assures maximum capacity of the refrigeration plant at all times.

15. Booster Conveyor

PORTABILITY, combined with adjustability, is incorporated in a new 15-ft. booster conveyor offered by Sage Equipment Co., 30 Essex St., Buffalo 13, N. Y. Each end of the conveyor can be raised or lowered independently by a positive handwheel. The unit is built with a 24-in. wide, three-ply belt. Floor locks are provided to prevent the machine from moving while in position. Belt motion is reversible for transportation in either direction.

16. Hot Materials Belt

CULMINATING nearly 10 years of experimental work in the reinforcement of rubber with glass fibers, the Hewitt Rubber Division, Hewitt-Robins, Inc., Buffalo 5, N. Y., has announced a hot materials conveyor belt and a rubber hose, both reinforced with glass fiber. This is said to be the first commercial use of glass reinforcement for either purpose. Fiberglas fabric is used in producing the belting, while Fiberglas yarn is the reinforcing material in the hose. Earlier experimental work, which was halted by the war, has been continued since the war and it is now claimed that the new hot materials belt will not char or lose strength at temperatures under 350 deg. F., nor will it stretch. In one foundry, such a belt operated on sand at 400 deg. F. and gave 2½ times longer service than previous belts employing cotton and asbestos reinforcement. Similarly the new glass reinforced steam hose is claimed to give improved service life, providing increased flexibility under high temperature conditions and resistance to hardening and stiffening.

17. Chemical Tanks Heliarc Welded

Heliarc inert-gas-shielded arc welding is being used increasingly in fabrication of special metals. Shown here are tanks of Everdur being fabricated by the Consolidated Steel Corp. of Texas. The argon gas shield for the electrode and weld area eliminates the need for flux and is said to produce smooth, neat welds which require no grinding. The tanks are 8 ft. in diameter and 18 ft. in length, employing 3/16 in. metal for the shell and ¼ in. for the head. Of all the common metals and alloys, only copper requires a flux when welded by this process.

18. Regulating Valve

SIZES from 1¼ to 2 in. are available in a new automatic valve for pressure-reducing and regulating service, recently announced by the A. W. Cash Valve Mfg. Corp., 6612 East Wabash Ave., Decatur, Ill. Designated as the Type E-41 Cash-Acme, the new valve

Permutit's WATER BARGAIN!

Slash costs up to 95%

Replace high-priced distilled water with Permutit's low-cost demineralized water

Compare costly, sparingly used distilled water with Permutit's Demineralized Water . . . it's up to 95% cheaper . . . it's a bargain that's good for nearly as many uses as distilled.

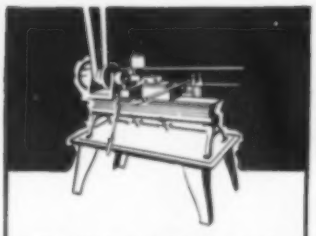
In Permutit's Demineralizing process, Zeo-Karb H*, Permutit's acid regenerated organic cation exchanger, replaces metallic cations in the water with hydrogen ions, converting the salts present into corresponding acids. These acids are then removed from the water by De-Acidite*, a resin type anion exchanger.

For full details on this economical demineralized water write to The Permutit Company, Dept. CE-6, 330 West 42nd Street, New York 18, N. Y., or to the Permutit Company of Canada, Ltd., Montreal.

*Trademark Reg. U. S. Pat. Off.

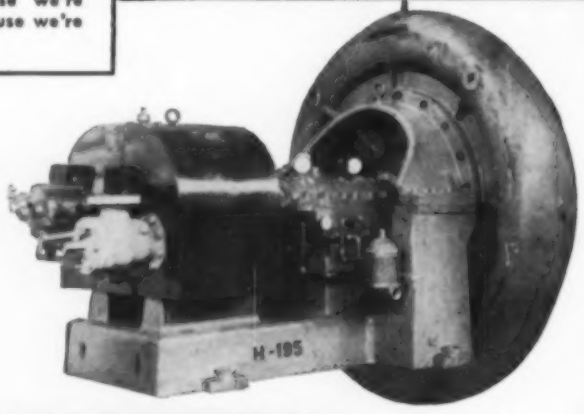
Permutit

WATER CONDITIONING • ION EXCHANGERS • MATERIALS & EQUIPMENT



The first successful turret lathe and the first Roots Blower were built in the same year . . . 1854. We're not good because we're old, but old because we're good.

Exclusive Service... R-C dual-ability



Type OIB, R-C Centrifugal Gas Exhauster in chemical plant service. Capacity 14,500 CFM.

Special R-C Rotary Positive Blower, handling 225 CFM of CO^2 gas, at 5 lbs. pressure, in chemical plant.

You obtain an important, exclusive advantage when you consult us about problems of moving air or gas. That is, our *dual-ability* to supply either Centrifugal or Rotary Positive units.

This *dual choice* allows you to match equipment exactly to your needs, in capacities, pressures and other characteristics. You can have standard Rotary Positive units from 10 CFM up to 50,000 CFM, or Centrifugal units from 2,000 CFM up to 100,000 CFM.

So, utilize this exclusive *dual-ability* by consulting us on all your blower and gas pump requirements. The economy and dependability of R-C Blowers have been proved for almost a century.

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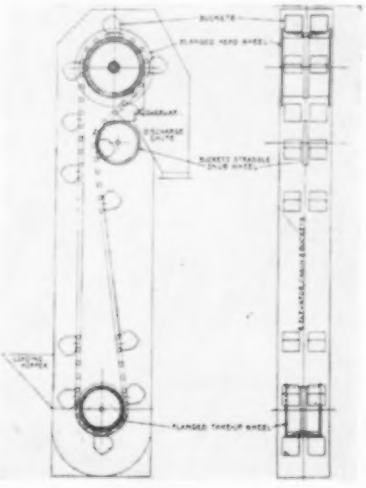
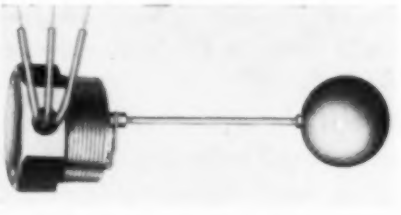
is of all-bronze construction, available for pressures up to 250 lb. Features include a readily replaceable seat, a stick-resisting Hycar washer, yoke type construction, and neoprene seats.



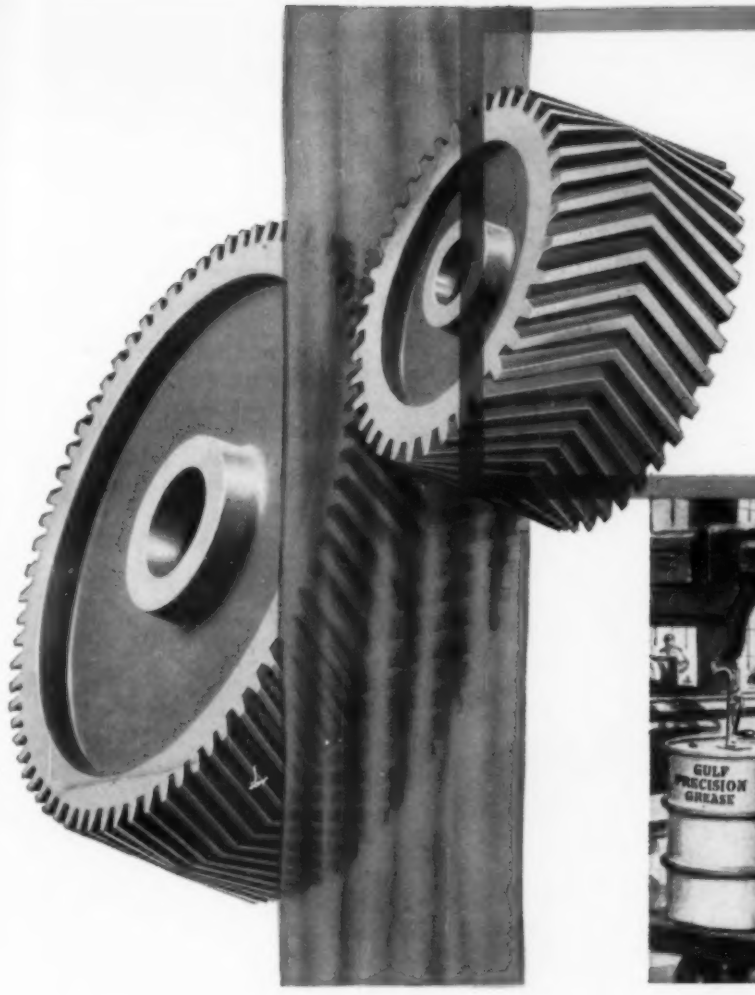
19. Bucket Elevator

AN IMPROVED bucket elevator of the so-called "Perfect-Discharge" type, in which an idler or snub wheel beneath the head wheel improves discharge characteristics, has been announced by Beaumont Birch Co., Schaff Bldg., Race St., Philadelphia, Pa. Designed for handling chemicals and bulk materials, particularly difficult materials that are hot, light, fluffy, fine, coarse, abrasive, fragile or sticky, the elevator uses a single-strand chain and a duplex bucket arrangement to permit high capacity when operating in either slow or high speeds. Regardless of speed, it is claimed that all material discharges into the head chute without spillage and without need to maintain any particular ratio between bucket speed, head wheel diameter, bucket size and bucket spacing. A 225 deg. chain contact around the head wheel permits the use of a traction wheel drive, eliminating the need for shear pins and slip couplings. Furthermore, omission of teeth from the head wheel is said to reduce wear on the chain.

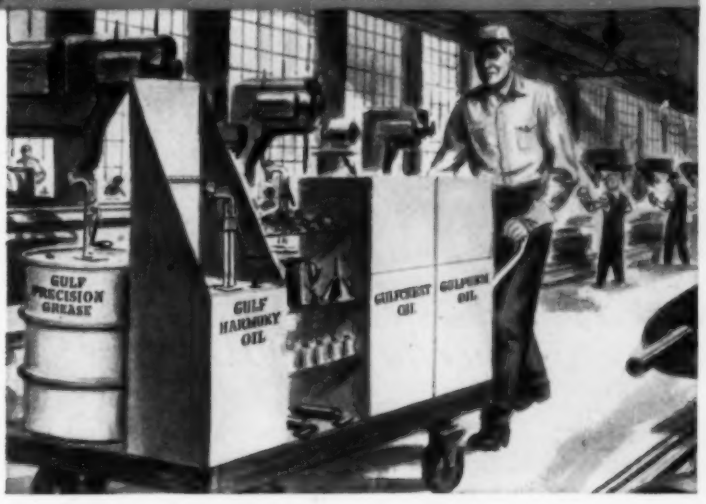


20. Level Control Switch

SNAP ACTION has been incorporated in a new float switch unit for level control service announced by Magneswitch, Inc., 4231 South Western



How much does the best lubrication cost?



"Nothing," say many plants. "It's more than paid for by savings in maintenance costs."

THIS statement has real meaning when the best oils are selected and properly applied.

"It has been real economy for us to invest in Gulf quality lubricants," says the Superintendent of a large aircraft engine plant. "With better lubrication, we have been able to maintain a higher rate of production and at the same time make sizable savings in maintenance costs. These benefits more than pay the entire bill for the better oils we are using."

As a part of your continuing effort to reduce costs and improve production, ask a Gulf Lubrication Engineer to assist you in installing improved lubrication. In his broad experience, he has found literally dozens of ways to save money and increase efficiency through the proper selection and application of better oils and greases.

This kind of lubrication service has a real dollar and cents value to you. Write, wire, or phone your nearest Gulf office today.

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GULF INDUSTRIAL LUBRICATION

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Expert Lubrication Engineering Service

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OIL-MAN'S Magic Number TO LICK CORROSION

. . . perhaps YOU have one, too!

DOWN in the oil fields, corrosion was playing havoc in gas condensate, high pressure wells. Equipment replacements were often needed at 30 to 40 day intervals.

Lebanon metallurgists and engineers made a searching analysis after which they came up with Circle L 12—a 12% Chromium Alloy. It brought good news to oil men because equipment life was extended appreciably. In some instances, examination disclosed no corrosion after more than a year.

The physical properties of Circle L 12 comply with the specifications of the American Petroleum Institute. It likewise meets ASTM specifications A-296-48 Grade 10.

What we have done for the oil industry, we can also do for you. Tell us your particular corrosion troubles. Perhaps one of the new Circle L Alloys will be your answer to longer equipment life.

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NOMINAL PHYSICAL PROPERTIES

API—Normalized and Drawn	
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Yield Point	65,000
Elongation in 2"	18%
Reduction of Area	30%
Oil Quenched and Tempered	
Tensile Strength	105,000
Yield Point	90,000
Elongation in 2"	17%
Reduction of Area	35%

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"In The Lebanon Valley"
ORIGINAL AMERICAN LICENSEE GEORGE FISCHER (SWISS CHAMOTTE) METHOD

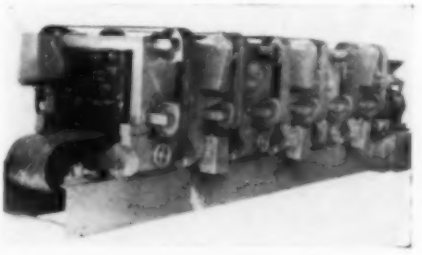
LEBANON ALLOY AND STEEL Castings

CIRCLE L

Boulevard, Chicago 9, Ill. The switch is of the magnetic actuated type, requiring no packing boxes, bellows or diaphragms, and no direct connection between the level-sensing float and the switch proper. The float member is of conventional design except that it is fitted with a magnetic stainless steel element located near the pivot point. It also incorporates a differential adjustment for varying the leverage exerted by the float. As the float rises, it brings the magnetic element into close proximity to the switch. Inside, the magnet snaps toward its armature, thus operating the switch. On falling level, the magnet snaps back to its original position, remaking the original circuit and breaking the other.

21. Skid-Pallet Truck

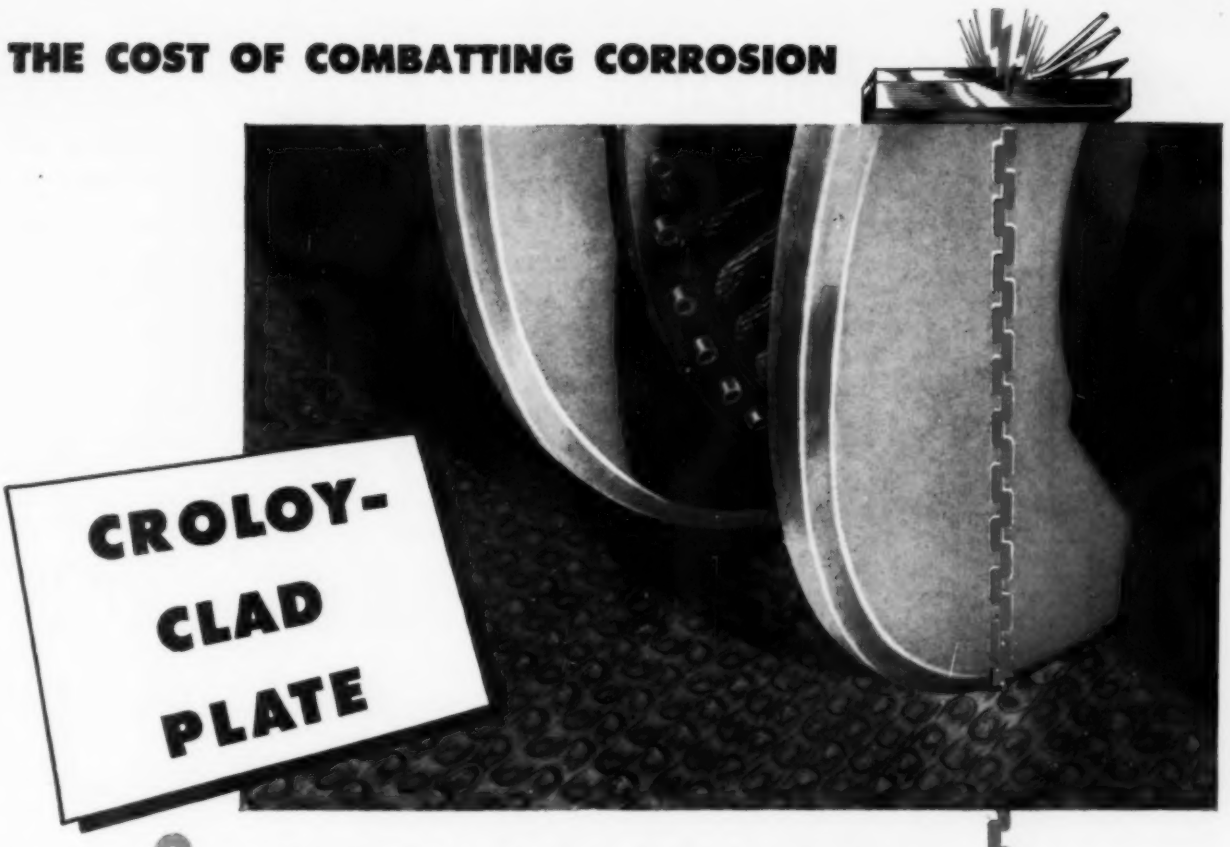
BOTH SKIDS and pallets can be handled with a new Worksaver electric-operated, hand-guided fork truck now being offered by the Materials Handling Division of the Yale & Towne Mfg. Co., Philadelphia, Pa. This truck, as the illustration shows, is essentially of the pallet type, but it has been fitted with a simple fabricated superstructure which folds down over the pallet lifting frame to make the unit suitable for handling skids. The standard model can handle skids from 6 to 12 in. high. When not in use, the frame locks in a vertical position for pallet handling.



22. Magnetic Separator

FOR THE separation of magnetic and non-magnetic materials, some of which are said never to have been separated magnetically before, the

CUTS THE COST OF COMBATTING CORROSION



COMBINES 9 MONEY-SAVING ADVANTAGES

The advantages listed at the right explain why B&W Croloy-Clad Plate has gained wide acceptance for fabricating process equipment requiring corrosion-, heat-, and oxidation-resistance surfaces; and protection against product contamination. It has proved to be the most economical solution to many diversified problems in refineries and chemical plants, calling for protection against destructive conditions.

Croloy-Clad Plate is produced by an exclusive B&W process which bonds a corrosion-resistant alloy cladding to a base metal. Newest machine for producing Croloy-Clad Plate is partially shown above. It represents an important advance in the art of seam-welding "clad" steels for fabrication into cost-saving process equipment.

Send for new booklet describing this versatile economical material.

- Alloy cladding is bonded to base metal with resistance welds.
- Bond offers high resistance to failure due to repeated heating and cooling.
- Corrosion-resistant lining of known thickness is provided over full surface area.
- Layer construction of cladding permits variation in thickness for specific requirements.
- Full corrosion resistance of lining retained by heat treatment.
- No interface carbon migration occurs between base metal and Croloy lining.
- High strength of bond permits the welding of trays, supports, and other internal fittings directly to the Croloy lining.
- Croloy-Clad Plate fabricates as easily as plain steels, and without special precautions.
- You pay no premium for the advantages of Croloy-Clad Plate.

S-84

PROCESS EQUIPMENT — Alloy, Clad, and Bonded Pressure Vessels . . . Heat and Abrasive-resistant Alloy Castings . . . Special Process Equipment.

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OTHER B&W PRODUCTS — Stationary and Marine Boilers . . . Boiler Components . . . Chemical Recovery Units . . . Pulverizers . . . Fuel Burning Equipment . . . Refractories . . . Seamless & Welded Tubes.

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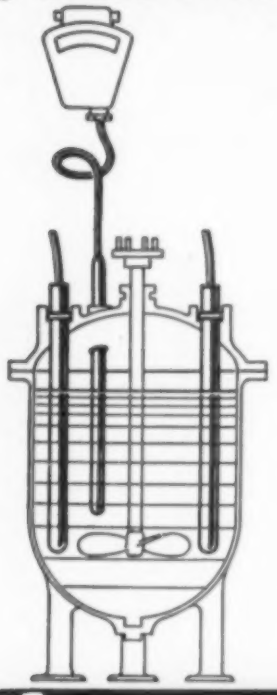
*Amersil** IMMERSION HEATERS

specifically designed for

CHEMICAL PLANT WORK



offer the following advantages over conventional construction:

- **High heat efficiency.**
- **Rapid evaporation due to high heat transfer rate—up to 200 watts per square inch of heater shell surface.**
- **A minimum of obstruction due to compactness.**
- **Are chemically resistant to highest concentration of acids at high temperatures.**
- **With enclosed thermal element extremely accurate heat control is maintained.**
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Time Saving, Automatic Samples *with* GEARY-JENNINGS SAMPLER

Adaptability Geary-Jennings Samplers are designed to sample either wet or dry material. Successfully handles ore, mill pulp, scrap metal, corn grits, malt, coal, corrosive solutions, potash, textiles, cement and phosphate.

Accurate Samples result from the Geary-Jennings operation because the cutter travels completely across and at right angles to the stream on every stroke.

Representative Samples are assured by electrically-controlled timing and by the Geary-Jennings principle of taking "all of the stream—part of the time."

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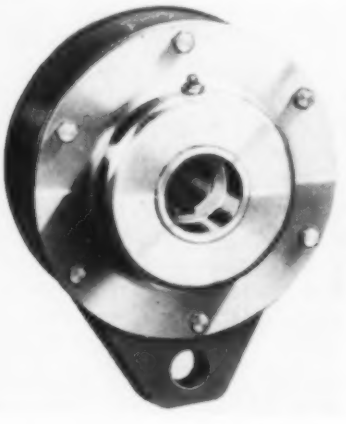
Jersey City 6, N. J.

FOR MORE INFORMATION
See Reader Service Coupon on pages 163-164

Dings Magnetic Separator Co., Milwaukee, Wis., has introduced a new super-high-intensity cross-belt separator designated as Type E. This separator is available with any number of cross belts. For example, an eight-belt separator can concentrate eight separate magnetic products and one non-magnetic. This is accomplished by varying the strength of each cross belt magnet to permit separation of materials having different magnetic susceptibilities. Among the separations now being made are ilmenite, monazite, chromite, garnet, epidote, wolframite and pyrrhotite. To secure a high degree of selectivity the machine employs a new high intensity magnetic pole, hand-wheel adjustment of air gaps, and variable-speed drive of the main belt.



23. Conveyor Backstop

To avoid the possibility of damage to the machinery or the material being handled in the event of accidental reverse operation of conveying equipment such as belt conveyors, windlasses, winches and elevators, an instantaneous backstop has been developed by the Falk Corp., 3001 West Canal St., Milwaukee 8, Wis. The gripping action is said to take place at the precise moment that forward rotation ceases, thus reducing to a minimum the possibility of shock or strain.

Equipment Briefs

24. Designed for chemical and petroleum industry applications, for Class I, Groups A and B hazardous locations, a new explosion-proof lighting fixture is being offered by Safe Light-

ORONITE CHEMICAL COMPANY

REG. U. S. PAT. OFF.

THE NAME TO WATCH IN CHEMICALS

USE ORONITE POLYBUTENES

FOR ELECTRICAL INSULATION

Polybutenes play an important part today in the field of electrical insulation. They are highly adaptable in manufacture of flexible insulated coatings and impregnated paper insulation.

Where electrical insulation material requires high dielectric strength, low power factor, stability and flexibility—you will find Oronite Polybutenes extremely useful.

This heat resistant non-drying product is available in eight grades of viscosity to meet specialized conditions. Polybutenes can be mixed with many rubber, resin, asphalt, pigment, and adhesive dispersions.

There are many other industrial applications for Oronite Polybutenes. A few of these are listed in the column to the right. Your request for more detailed information will be promptly sent from any one of the offices listed below.

CHECK THESE OTHER APPLICATIONS FOR POLYBUTENES

CAULKING AND SEALING COMPOUNDS
Soluble in raw and boiled linseed oil. Outstanding pigment carrying and non-drying characteristics.

WATERPROOF PAPER LINERS
Imparts greater adhesion and flexibility, reduces cracking and chipping.

FIBER TREATMENT
Improves thread strength, water resistance, helps spinning.

INKS
Formulation of paste inks and cartridge inks. Excellent pigment carrying properties, compatible with fatty acids, oils and metallic soaps.

INSECTICIDES
For moisture resistant formulations. For compositions that require high resistance to weathering.

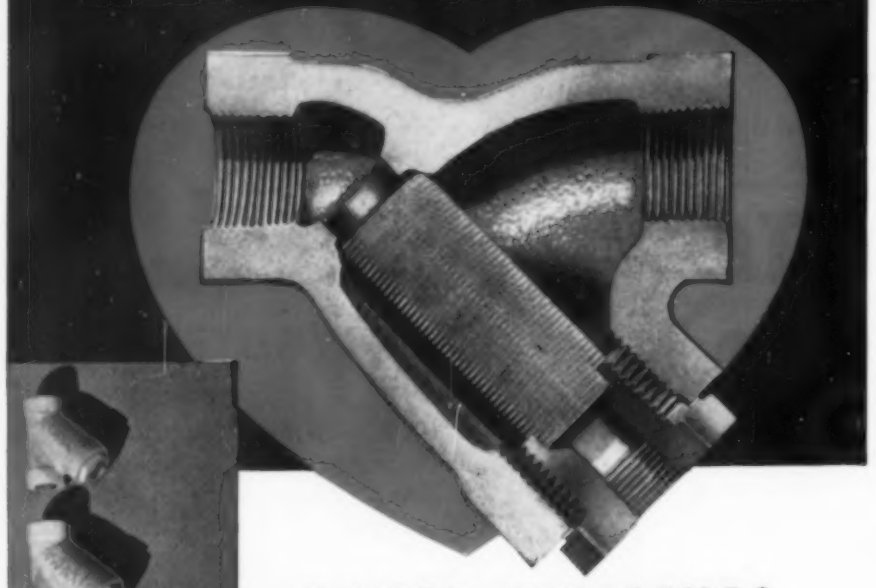
RODENT EXTERMINATION
Used in paste formulations. Is an excellent carrier of inert filler, imparts moisture resistance, helps retain surface tack.

WATERPROOFING
Formulation of waterproofing coatings. Non-separating, high coating power, better adhesion and flexibility.

ORONITE CHEMICAL COMPANY

38 SANSOME STREET, SAN FRANCISCO 4, CALIFORNIA
STANDARD OIL BLDG., LOS ANGELES 15, CALIFORNIA
30 ROCKEFELLER PLAZA, NEW YORK 20, NEW YORK
600 S. MICHIGAN AVENUE, CHICAGO 5, ILLINOIS

The SCREEN of the YARWAY STRAINER



MAKES PIPELINES *Lifelines*

- The heart of a strainer is its screen . . . and the screen in Yarway Strainers keeps pipelines open . . . prevents rust, scale and dirt from clogging equipment.
- *Screens* are of high-grade monel woven wire, fine enough for required straining service, yet having ample free area for passage of clean condensate, light oil or other fluids. Perforated screens if desired.
- *Screen cap* is made with straight thread, machined face and spark-plug-type gasket for attachment to body. Permits easy removal for cleaning. Insures proper alignment of screen when it is replaced in body.
- *Body* of Yarway Strainer is iron or steel, cadmium-plated for protection against corrosion and for better appearance.
- Available in six sizes, ½" to 2", for pressures to 600 lbs. Stocked and sold by 150 Mill Supply Houses. Reasonably priced.
- Hundreds of thousands in use. See your nearest dealer, or write for Bulletin S-201.

YARNALL-WARING COMPANY
137 MERMAID AVENUE PHILADELPHIA 18, PA.

YARWAY STRAINERS
"Police the Pipelines"

ing, Inc., 90-16 Astoria Blvd., Jackson Heights, L. I., N. Y. This is said to be the first lighting fixture ever approved by Underwriters' Laboratories for this particular group of hazards. It covers atmospheres containing acetylene and hydrogen, as well as other gases of equivalent hazard. The less hazardous gases covered in Groups C and D hazards are also covered. Protection is secured by operating the fixture under an air pressure of about 10 lb. Should the pressure decrease below about 3 lb. for any reason, the lamp automatically switches off.

25. A TEMPLATE of instrument symbols for draftsmen, designated as No. 47, is being produced by Rapidesign, Inc., P. O. Box 592, Glendale, Calif. It is made in clear plastic, particularly for drafting work in the process field.

26. FOR CORROSIVE service the Brooks Rotameter Co., Lansdale, Pa., has introduced a full-view rotameter with safety shielding. The meter has both internal and external metal parts of stainless steel, or other special metals as required. It is also available with only the internal metal parts of special metals. The meter is produced in sizes from ¼ to 1¼ in. with screwed connections, and in sizes from 1 to 3 in. with flanged connections. The capacity range is as high as 120 gpm. for liquids or 240 cfm. for gases.

27. SEVERAL new modifications of its Solu Bridge controllers have recently been announced by Industrial Instruments, Inc., 17 Pollock Ave., Jersey City 5, N. J. One is a new type for measuring concentration of nitric acid, and another for the percentage of ammonia in water solutions. For continuous recording and automatic control installations where temperature variations of the electrolyte make conductivity measurements difficult, the company has developed a new type combined measuring and reference conductivity cell to provide automatic temperature compensation. Operating conditions may include corrosive solutions, temperatures to 150 deg. C. and pressures to 50 psi.

28. ALLIS-CHALMERS Mfg. Co., Milwaukee, Wis., has completed an arrangement with the RCA Victor Division of the Radio Corporation of America for the distribution of RCA high-frequency heating equipment and RCA metal detectors, in addition to its own line of electronic heating equipment. The new arrangement now makes induction heaters up to 200 kw. and dielectric heaters up to 125 kw. available through Allis-Chalmers.

NEW PRODUCTS AND MATERIALS

Richard W. Porter, ASSISTANT EDITOR

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FOR MORE INFORMATION
See Reader Service Coupon on pages 163-164

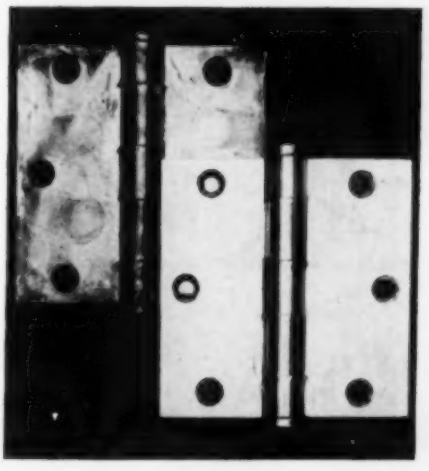
51. Packaged Radiochemicals

A COOPERATIVE venture has been undertaken by the Atomic Energy Commission and Tracerlab, Inc., 55 Oliver St., Boston, Mass., to manufacture and stock a number of compounds tagged with carbon-14. Tracerlab, Inc., is commencing this work with 100 millicuries of carbon-14. The following are compounds which will be available within the next six months: barium carbide, acetylene, sodium cyanide, methyl alcohol and methyl iodide, carboxyl-labeled ethyl alcohol, ethyl iodide, methyl-labeled acetic acid, acetyl chloride, ethyl acetate, methyl-labeled ethyl alcohol and ethyl iodide. New compounds will be added to the list occasionally from time to time.

Prices have not been finally determined but it is expected that they will be in the range of $200 to $500 per millicurie for most compounds. The minimum amount for sale will normally be one millicurie but, in some instances, smaller quantities will be available upon request. All compounds will be packaged in sealed glass ampoules and, whenever possible, will have a minimum dilution of activity. Standards for correlating the Tracerlab, Inc., millicurie with that of Oak Ridge will be set up to permit the customer to obtain activity measured in accordance with the Oak Ridge millicurie.

52. Zirconium Opacifier

A MIXTURE of controlled crystalline phases of zirconia, Lufax 77A, has been placed on the market by Rohm & Haas Co., West Washington Square, Philadelphia, Pa. Porcelain enamels opacified by Lufax 77A are said to be characterized by stability; gloss and opacity remaining constant over a wide firing range and color stabilized in the desirable blue quadrant. Especially designed for zirconia opaque enamels, it provides nuclei for the crystallization of zirconia from the molten enamel. In practically all of the commercial zirconia frits, especially where maximum glass and opacity are required along with high impact strength and scratch resistance, the manufacturer expects Lufax 77A to find extensive use.



Bright plating is aided by addition of Actane to the pickling solution. Left—Ordinary pickling solution was used; right—Actane was added.

53. Pickling Additive

A NEUTRAL activating compound that is added to hydrochloric or sulphuric acid pickles, Actane, has been put on the market by Ethone, Inc., New Haven 2, Conn. It disperses and removes colloidal films that may be deposited during the cleaning of metal surfaces. When added to acids for dipping of non-ferrous metals such as copper and brass prior to bright nickel plating, it is particularly beneficial. It keeps the acid dips used in all plating cycles clearer and makes rinsing off the acid easier.

54. Soya Protein

SOME months ago Spencer Kellogg & Sons, Inc., Decatur 80, Ill., began producing Kelkote. A soy protein product of low cost, high refinement and fine granulation, it should find a market in the paper, wallpaper and protective coating fields. It can be hydrated by mixing with two parts of water to give a stable suspension. Although increasingly unstable at pH 7 or less, it forms stable suspensions with hydroxides of the monovalent metals and many of their salts. It is also sensitive to the di- and trivalent metal hydroxides and salts of these metals. To bring out the maximum adhesive quality of Kelkote mixes, it must be cut or solubilized. Monovalent metal hydroxides or, preferably, their salts can do the cutting; ammonium hydroxide and ammonium salts can also be used. The hydroxides cause considerable color development.

Chemical analysis shows Kelkote to be made up of the following components in percentage: moisture, 8.84; fat, 0.58; protein (N x 6.25 percent), 53.90; crude fiber, 2.15; ash, 5.54; N.F.E., 28.99. It is light cream in color and will pass through a No. 325 U. S. Bureau of Standards sieve. Its bulk density is 30 lb. per cu. ft. (approx.); bulking value, 11.5 lb. per gal., (approx.). Viscosity may vary widely depending on the amount of liquid available and type of cutting agent used. Most solutions have thixotropic characteristics.

Kelkote is compatible with many of

It's an
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FILTER

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COMPACT, PORTABLE

This Alsop *"Sealed-Disc"* Filter positively removes all impurities. Its unique design assures unsurpassed performance on intermittent or continuous operation and with little or no supervision. You'll find this compact filter always ready for instant use, completely sealed, leak and drip proof and easy to move to wherever needed.

Alsop filters of various sizes, made of suitable materials, are at work on chemicals, plating solutions, liquid plastics, liquid soaps, drugs, syrups, foods, beverages, oils, fats, alcohol, water etc. Write for complete details.

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ENGINEERING CORPORATION
Filters · Filter Discs · Sheets · Mixers · Agitators
306 White Road, Milldale, Conn.

OLD EQUIPMENT WORN OUT?
look to LEE Kettles
FOR CORROSION-RESISTANT EQUIPMENT

WRITE FOR NEW INFORMATIVE BULLETIN

LEE METAL PRODUCTS CO. INC.
417 PINE STREET . . . PHILIPSBURG, PA.
ALL LEE KETTLES ARE MADE TO A.S.M.E. CODE

the recognized protective coating materials. With casein, a 50 percent Kelkote mixture is best for water emulsion paints and allied types of materials. As adhesives for paper coating, the mixtures are about as strong as casein alone. With isolated proteins, results should be similar to those obtained from casein but optimum proportions are not definite. With latex, Kelkote is said to produce an adhesive of durability, flexibility, waterproofness and strength; to paper coatings the mixture is said to give a high degree of finish and superior printing qualities. It is also compatible with standard pigments and dispersing agents such as sodium silicate, tetra sodium pyrophosphate and sodium hexametaphosphate. A preservative other than formaldehyde should be added to Kelkote mixes to prevent spoilage. Formaldehyde is not desirable because of its hardening action.

55. Synthetic Wax

MANY plastics pick up and hold a static electric charge on their surfaces. Acrawax C, made by the Glyco Products Co., Inc., 26 Court St., Brooklyn, N. Y., gives anti-static properties and anti-blocking action to the surfaces when incorporated in the molding. It can be used on plastic sheeting and packaging films and on parts that are rubbed, touched or moving rapidly (as on shafts).

56. Wetting Agent

A CATIONIC wetting agent and emulsifier, Catiosan, is being made by the Onyx Oil & Chemical Co., Jersey City 2, N. J. It combines detergent and germicidal effects. It is suggested for such products as liquid bactericidal soaps, impregnated paper towels for dental, medical and clinical use. A complex amido condensation product, Catiosan is an amber paste with a fatty odor. It is compatible with acids and hard water, incompatible with alkalis and anionic surface active agents. Stable to heat, normal use and storage, it is soluble in water, hot alcohol and toluene solutions.

57. Stainless Steel Electrodes

FEATURING flexible operation in any position of welding, two new electrodes, 29-9 and 29-9 Mo, are being made by the McKay Co., York, Pa., to meet specifications of fabricators of stainless steels. They are available with either d.c. or a.c.-d.c. coating. Normal operating currents are slightly higher than those used with ordinary stain-

HEYDEN

CHLORINATED BENZENES

MONOCHLOROBENZENE

ORTHODICHLORO-BENZENE

PARADICHLORO-BENZENE

TRICHLOROBENZENE

Heyden chlorinated benzenes (benzols) are widely used in organic syntheses and have extensive applications in the manufacture of solvents, insecticides, textile chemicals, medicinals, weed killers, polishes, explosives, soil and sewage disinfectants, protective coatings, and many other industrial and commercial uses.

AVAILABILITY

Heyden Chlorinated Benzenes are shipped in seller's cars from our plant at Memphis, Tennessee: Tank cars, approx. 74,000 lb.; drums, approx. 475 lb.

MONOCHLOROBENZENE is one of the most extensively used Heyden chlorinated benzenes (benzols). It is important as an organic solvent and as an intermediate in formulation of dyes, herbicides, pharmaceuticals, insect exterminators, etc.

PROPERTIES

A clear, almost colorless liquid practically insoluble in water. Freely miscible with most organic liquids.

Boiling range—Within 1°C. including 132.1°C. at 760 mm.	
Freezing Point	−45°C.
Specific Gravity at 25/25°C.	1.105
Flash Point	
Closed Cup	29°C.
Open Cup	90°F.
Copper corrosion	negative

PUT THE PLUS IN YOUR PROCESS!

- ...Constant source of supply.
- ...Production control through uniformity.
- ...Exacting specifications...assured quality.
- ...Extensive facilities of 5 modern plants.

Serving Industry Through Finer Chemicals

HEYDEN *Chemical Corporation*

393 SEVENTH AVENUE, NEW YORK 1, N. Y.

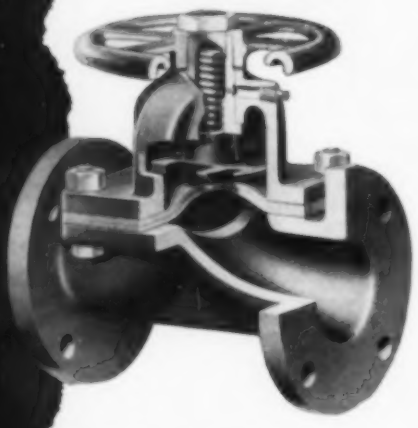
CHICAGO OFFICE, 20 North Wacker Drive
PHILADELPHIA OFFICE, 1700 Walnut Street

FINE HEYDEN CHEMICALS

Benzaldehyde • Benzoates • Benzoic Acid Benzyl Chloride • Bromides • Chlorinated Aromatics • Medicinal Creosotes • Formates Formaldehyde • Formic Acid • Glycerophosphates • Medicinal Guaiacols • Hexamethylenetetramine • M. D. A. (Methylene Disalicylic Acid) • Paraformaldehyde Parahydroxybenzoates • Penicillin Pentaerythritols • Salicylates

Here is the valve that *Eliminates* these common troubles

CORROSION
CONTAMINATION
LEAKING
CLOGGING
PACKING REPLACEMENT
STICKING
WIRE DRAWING



HILLS-McCANNA
Saunders patent
diaphragm valves

The diaphragm in this unusual valve design serves a double purpose. *First,* it acts as a gasket to isolate bonnet and working parts from the flow, eliminating troublesome stem packing, preventing corrosion of working parts and contamination of materials being handled. *Second,* as the closing medium, it provides a resilient, unfailing, leakproof closure, even when scale or other foreign matter settles on the seat. Maintenance consists only of occasional change of diaphragm. No need to remove valve body from line.

Write for Bulletin V-47 detailing all the benefits of this radically different, proved-in-service valve design. Wide choice of body and diaphragm materials available to meet your requirements. HILLS-McCANNA CO., 2341 W. Nelson St., Chicago 18.

For pressures to 150 Psi. Max. recommended temperatures standard valves 180° F.; others to 220° F. Sizes ¾" to 14" both screwed and flange. Handwheel and lever operated types; air, motor or chain operated.

HILLS-McCANNA
diaphragm valves
saunders patent
Proportioning Pumps
Force-Feed Lubricators · Magnesium Alloy Castings

FOR MORE INFORMATION
See Reader Service Coupon on pages 163-164

less steel electrodes. Typical test results of the weld metal show that as deposited it is of excellent quality, inclusion and porosity free, with a tensile strength of approximately 111,000 psi. and 35 percent elongation in 2 in. Some applications of this electrode have been the welding of steam and gas turbine blades, and high temperature and high pressure pump parts. Another application of the electrode is in the resurfacing of worn parts.

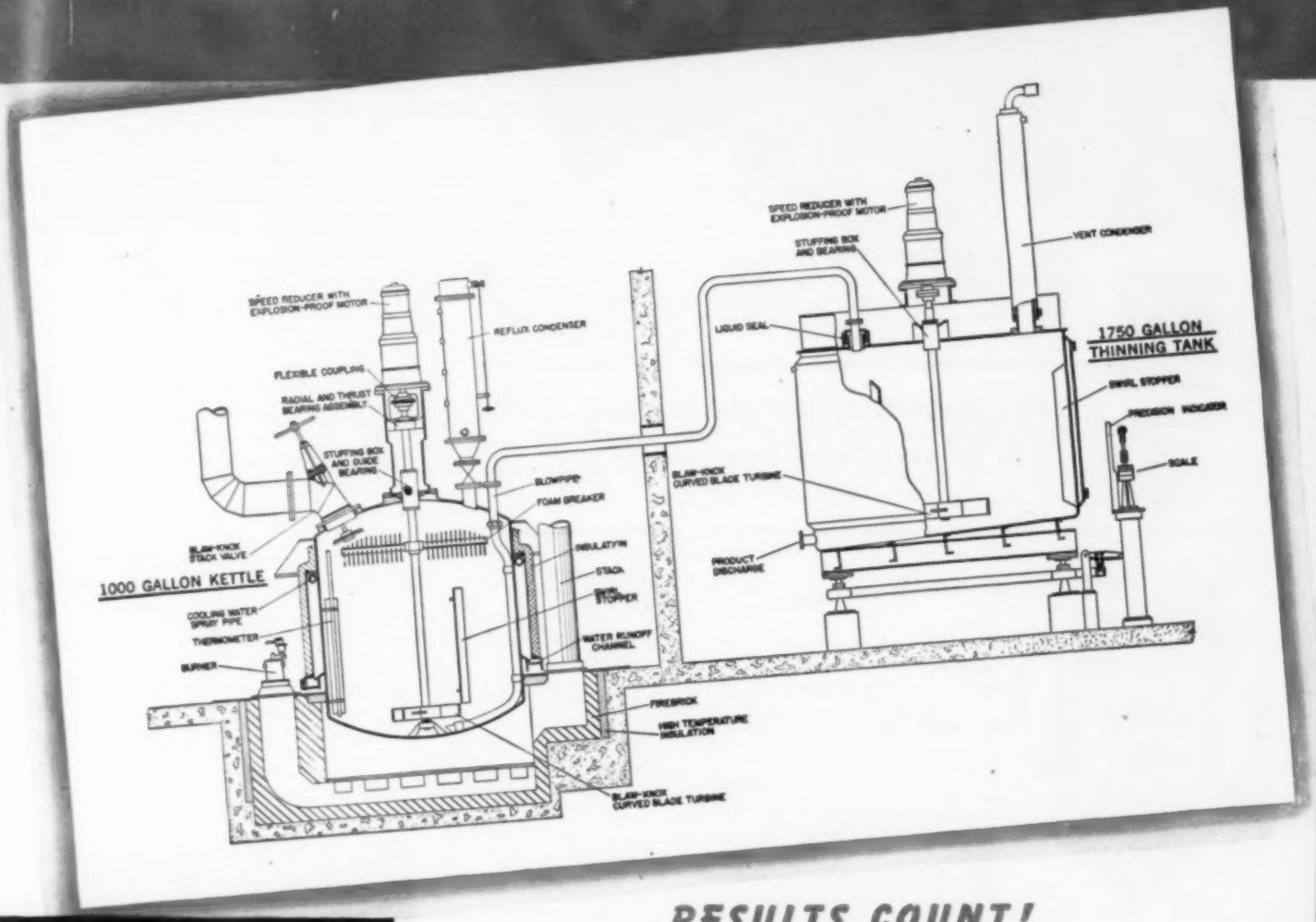
58. Synthetic Sapphire Balls

STANDARDIZATION tests on sapphire balls now being made by The Linde Air Products Co. Unit of Union Carbide and Carbon Corp., 30 East 42nd St., New York, N. Y., show a low coefficient of friction (0.140 for steel pivot in sapphire ring) and a hardness second only to diamond. The balls are polished to a sphericity of less than 10/1,000,000 and are unaffected by acid. Unicrystalline and homogenous, the ball's smooth surface prevents failure due to factors of stress or chemical action. Aging and creep phenomena do not appear in sapphire balls. Possibilities for their use are for high-temperature bearing assemblies and for bearing installations subject to contact with chemical agents. These bearings need not be lubricated in some cases. At the present time, however, clear sapphire balls are limited in quantity and size.

59. Fluorescent Plexiglas

A FLUORESCENT form of acrylic plastic has recently been announced by the Rohn & Haas Co., West Washington Square, Philadelphia. The plastic is impregnated during manufacture with fluorescent dye particles. Each particle of dye when struck by light rays entering the fluorescent sheet reflect the light in all directions. Most of the reflected rays, however, are trapped within the polished sheet and travel through it by repeated interior surface reflections to the edges where they escape in a high concentration of fluorescent lighting. Suggested uses for this material, known as fluorescent plexiglas, are for self illuminating lettering, decorative panels with edges or surface designs that glow under their

BLAW-KNOX DIRECT-FIRED RESIN PLANTS ARE SIMPLE, POSITIVE, AND INEXPENSIVE UNITS FOR RESIN MAKING, OIL BODYING, OR VARNISH COOKING



RESULTS COUNT!

Blaw-Knox Direct-Fired Kettle Installations give fast heating, rapid cooling, and close control. The following characteristics are typical for a 1000 gallon unit:

CHARGE: 600 Gallons Refined Linseed Oil **HEATING TIME: 65°F to 575°F in 140 minutes**

COOLING TIME: 575°F to 450°F in 47 minutes

Let us show you how well these units are adapted to your processing problems.

BLAW-KNOX DIVISION of Blaw-Knox Company

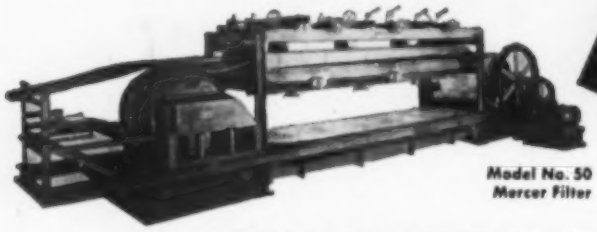
2090 Farmers Bank Bldg., Pittsburgh 22, Pa.

BLAW-KNOX

IMPLEMENTS THE PROCESS INDUSTRIES

MERCER
BAND Filters
FILTRATION
WASHING · DRYING

Low-cost Efficient Continuous Suction Process



Model No. 50
Mercer Filter

WRITE FOR MERCER FILTERS BULLETIN No. 70

PERFORMANCE—PROVEN FEATURES
Multiple washing zones. Evenly formed filtered cake. Varied thicknesses. Automatic cake discharge. Continuous filter medium cleansing. Low power consumption.

Arrange for Test
Mercer plant is equipped to conduct and report upon experimental tests made with samples of your materials. Inquire about this service.

"The Name that Carries Weight"

MERCER ENGINEERING WORKS, INC.
REPRESENTED BY MERCER-ROBINSON COMPANY, INC.
30 CHURCH STREET, NEW YORK 7, N Y.
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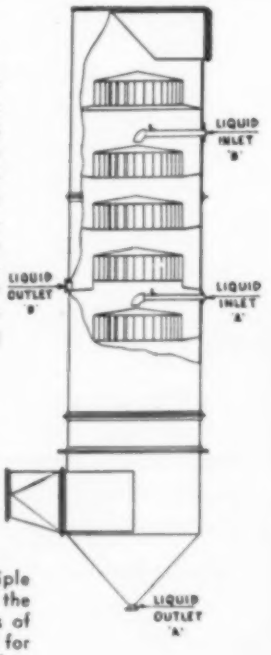
ONE PRINCIPLE ... MANY VERSIONS

Hydrogen sulphide gas, organic sulfonate dust, beryllium ore dust, mercury vapor bone dust, acid fumes . . . these are just a few of the chemical industry contaminants being removed or reclaimed from the air by Schneible Multi-Wash systems. Center of activity in every installation is the Multi-Wash Collector where the contaminated air comes into intimate, turbulent contact with the proper cleansing liquid.



MULTIPLE LIQUID INLETS FOR Schneible COLLECTORS

With no moving parts, the basic Schneible Multi-Wash Collector is readily adaptable to every condition. Where two or more scrubbing or absorbing liquids are required, for example, multiple liquid inlets are provided as shown. The air, whirling up through the impingement stages, passes through two, or more, separate series of liquid curtains and spray. Materials are enveloped and washed out for disposal or reclaiming . . . scrubbing liquid may be recirculated in most cases. Send for Bulletin 410.

CLAUDE B. SCHNEIBLE CO.
2827 Twenty-fifth St., Detroit 16, Michigan
Engineering Representatives in Principal Cities

SCHNEIBLE

own power, for dials, pointers, nameplates, and similar objects.

60. Mildew-Proofing Compound

A CHLORINATED phenol known as Compound G-4 being made by the Sindar Corp., 330 West 42nd St., New York 18, N. Y., is being used to mildewproof textiles and leather goods. Having a structural formula, bis (5-chloro-2-hydroxphenyl) methane, it melts from 165-169 deg. C., is pink or light tan in color. Originally developed as an antiseptic, germicide and fungicide for use by the pharmaceutical and disinfectant industries, Compound G-4 has been found relatively non-toxic and non-irritating. Company laboratory tests show that in cotton textiles a concentration as low as 0.25 percent of Compound G-4 on the basis of the dry weight of the cloth is sufficient to give protection from mildew.

61. Germicide

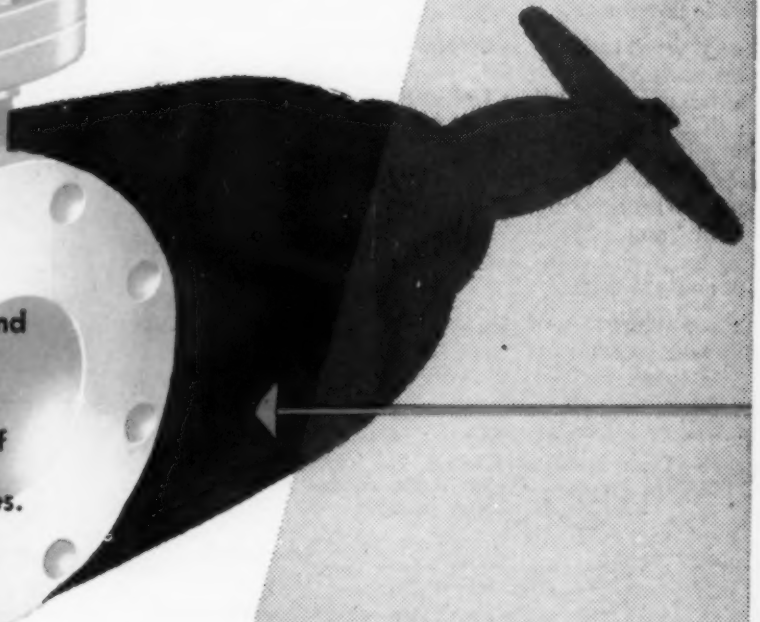
A GERMICIDE for sterilizing personal safety equipment and protecting workers from contamination through the use of such devices is being made by Willson Products, Inc., Reading, Pa. Non-corrosive and non-staining, the manufacturer says its 25 times more powerful than carbolic acid. It is said to be neither toxic nor irritating to the skin. The solution also acts as a deodorant and fungicide. As a spray, swabbing solution, or immersion solution for gas masks, goggles, welder's masks, respirators, safety shoes, boots or washable apparel, the germicide can be used in hot or cold water.

62. Abrasion Resistant Rubber. Maintenance is negligible in this shot blast room lined with Armorite. This compound is made by the B. F. Goodrich Co., Akron, Ohio.

X-RAY INSPECTION

another *plus* with COOPER *certified* STAINLESS STEEL VALVES

Cooper Certified Stainless Steel Valves are subjected to the searching eyes of giant X-rays capable of exposing hidden internal flaws undetectable by ordinary methods of inspection. Day after day, this modern X-ray equipment, plus Zyglo, Gamma-ray and mechanical inspections insure the soundness and efficient performance of Cooper Certified Stainless Steel Valves.



Est. 1922

Write for new Valve Catalog #51

SOLD THRU THE LEADING STAINLESS STEEL DISTRIBUTORS

Specialists in Corrosion Resisting Stainless Steel

THE COOPER ALLOY FOUNDRY CO.

HILLSIDE, NEW JERSEY

FROM

Beautifying Blondes

TO

Battling Bugs

Whether you make cosmetics or germicides—

crayons or rust preventatives—synthetic detergents or printing inks—polishing waxes or paints—carbon papers or plasticizers—whether you're interested in waterproofing or asphalt bonding, textile dyeing or ore flotation . . .

You'll want to know more about Armour's *Chemicals From Fats*, for the above widely contrasting applications indicate only a few of their many possible uses. These versatile industrial chemicals include the Armeens (aliphatic amines) and Armacs (amine acetate salts), the Armids (aliphatic amides), the Arneels (aliphatic nitriles), and the Arquads (quaternary ammonium salts).

To see what these high molecular weight aliphatic chemicals can do for you, write today for the following basic bulletins covering physical and chemical data as well as indicated uses:

"RNH_2, The Armeens, and RNH_2Ac, The Armacs";
"$RCONH_2$, The Armids"; "RCN, The Arneels";
"$RN(CH_2)_2Cl$, The Arquads".

From Penetrants to Repellents

The Armeens, when neutralized with acetic acid (thus becoming Armacs) act as highly effective penetration assistants—still they may be converted easily into equally effective water-repellents for textiles, ceramics, etc. Other uses include: cationic emulsification, ore flotation reagents, asphalt bonding, pigment grinding, synthetic detergents, chemical synthesis.

From Mutual Solvents to Emulsion Stabilizers

The Armids serve as mutual solvents for certain plastics and paraffin or microcrystalline waxes, making possible intermediate products combining some properties of each. Other uses include: emulsion stabilizers and thickeners, anti-scratch waxes for printing inks, dye solubilizers for carbon paper, anti-blocks for plastics, chemical synthesis.

From Plasticizers to Rust Preventatives

The Arneels are softening agents for various synthetic rubbers or elastoprenes and synthetic rubber-like elastics or elastoplastics. They are efficient softeners for acrylonitrile copolymers, polyvinyl and polystyrene derivatives. Other uses include: rust preventatives, lubrication assistants for textiles, waterproofing compounds, chemical synthesis.

From Textile Softeners to Germicides

The Arquads, used in concentrations of as little as 0.1-0.25%, are excellent cationic softeners. They greatly improve the hand of rayons, synthetic fibers and resin-treated fibers and offer additional advantages. Other uses include: high-potency germicides, fungicides and disinfectants, ore flotation reagents, antistatic polishes for plastics, cationic emulsifiers and detergents, water-treating chemicals, alkaline cleaning compounds.

MAIL THIS COUPON TODAY!

(attach to your business letterhead, please)

Please send me booklets checked:

☐ Armeens ☐ Armids ☐ Arneels ☐ Arquads

Name..... *Title*.....
Firm.....
Address.....
City..... *Zone*... *State*.....

ARMOUR *Chemical* **DIVISION**

ARMOUR AND COMPANY
1355 West 31st Street • Chicago 9, Illinois

MEN, MACHINES AND METHODS

Roger Williams, Jr., ASSISTANT EDITOR

Benefit Plans Can Backfire

Employee benefit plans, their scope and cost, can lead to labor troubles. The current strike threat at Oak Ridge and the recent AEC-contractors squabble spotlight the fact.

BACK in 1943 a chain of events began that seemed unimportant at the time, but the consequences five years later were almost drastic. They required a Presidential fact-finding board, a court injunction, and the services of federal conciliators to prevent a strike in one of our most important plants—the Oak Ridge, Tenn., atomic energy unit. The consequences may still be drastic.*

The dispute is in the Oak Ridge National Laboratory (Clinton Laboratory) and is now between the operator, Carbide and Carbon Chemicals Corp., and the union, Atomic Trades and Labor Council (A. F. of L.). But there are silent partners sitting looking on. They include Du Pont, the University of Chicago, Monsanto, and last but not least the Atomic Energy Commission.

Although a wage dispute is part of the problem, the major trouble revolves around employee benefit programs. The situation is clouded by the presence of two other plants, the Y-12 electromagnetic separation plant, and the K-25 gaseous diffusion separation plant. Basically, the dispute is caused by the difference in benefit plans between the laboratory and the two other plants.

When the laboratory went into operation in 1943 it was the first plutonium pile, outside of the small one at Chicago. Although designed with every reasonable precaution, there was still fear of unknown radiation effects. Consequently the laboratory was deemed more dangerous than the two separation plants. The result was that the government and Du Pont, the first operator, offered higher wages and better employee benefit programs than those for the separation plants.

As time went by, Du Pont moved out and the University of Chicago was the laboratory operator. Chicago continued the same plans. With the war's end, Chicago dropped out and Monsanto came in. Although the benefit plans in operation were different from those in effect in regular Monsanto plants, the same plans were continued. There was no real conflict in Monsanto's mind. Oak Ridge was something special.

Safety Record

Meanwhile two things had occurred. First, the facts did not justify the original pessimistic assumptions of radiation hazards in the Clinton Laboratory. Only two employees have been temporarily disabled by radioactivity, and they were back at work a month later. Not only that, but year after year the laboratory has had a better safety record than the neighboring separation units. In 1944 the laboratory had a frequency rate of 2.66 accidents per million man hours and a severity rate of 0.35 day lost per thousand man hours. The K-25 unit showed 8.09 for frequency and 0.21 for severity, while the comparable figures for Y-12 were 7.08 and 0.49. By 1947 all the plants had improved their frequency rates, but the laboratory was still the lowest by far. The laboratory showed 1.74 while K-25 had 2.76 and Y-12 had 4.81. Even on minor injuries the laboratory was well below the others.

The second factor was that Carbide and Carbon had taken over the operation of the separation plants from their wartime operators. Furthermore, these two plants had been organized by the CIO.

Wage Issue

So the fall of 1947 came along with the differentials in wages and employee benefit plans still favoring the laboratory, and a new union contract to be negotiated, primarily on wage issues. One of the factors bringing up the wage issue was the granting by Carbide of a 13½-c. wage increase to the employees of the K-25 plant.

Here began the rub. Monsanto was pulling out of Oak Ridge at the end of 1947, so it seemed unfair for them to negotiate a contract that a third party would have to fulfill. At that time it was thought that the University of Chicago would be the next operator, so Chicago representatives sat in on the original conferences. Then all of a sudden the Atomic Energy Commission changed its mind and signed an agreement to make Carbide and Carbon the next operator. Carbide would thus operate the entire Oak Ridge plant, including all three of its separate units.

So now Carbide moved into the new contract negotiations. But Carbide was on a hot seat. Here it was running three plants, within the same reservation, with two different unions, two different sets of wage rates, two different sets of benefit plans.

The result was that Carbide attempted to reduce the differential between the two sets of wages and plans. As the President's Board of Inquiry put it, "On the one hand, the Union desires to preserve differentials as to wage rates and conditions of employ-

Something New

Beginning with this issue is this new department. Intended for supervisory personnel, the department will cover such subjects as labor relations, plant operating policies, new laws and interpretations, benefit plans, training programs, and safety. The human side of the subjects will be the basic approach.

* This issue will be on the presses when the government's anti-strike injunction runs out on June 7.

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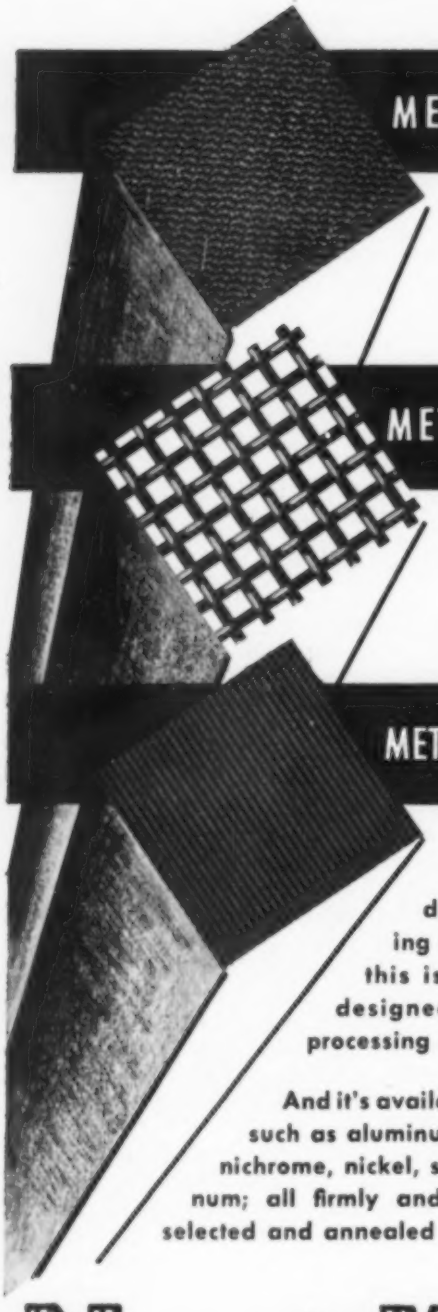

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ment that have been in existence in the Laboratory since its inception. On the other hand, the Company, now to be the operator of all three installations in the Oak Ridge area, desires uniformity of wage rates and conditions of employment and the elimination of the Laboratory differentials over the two nearby atomic-energy facilities." With the AFL in the laboratory and the CIO in the other two plants, this was sure to mean trouble whichever way Carbide went.

Benefit Differences

Other than the wage differential, there are five employee benefit differences that are causing trouble. They are assurance of continuity of operation without strikes, insurance and non-occupational disability benefits, vacations, the apprentice and training program, and the promotion system.

On continuity of operation, the union wants to sign away its right to strike and substitute a system of arbitration. The union feels the plant is too important to national security ever to be shut down by a labor dispute. On the other hand, Carbide has been quoted, "If at the end of (an agreed) time there is a dispute existing then we say the discussions on wages must cease and either they must go on and continue under the existing wage scale or else if the Union wants to exercise its economic power they can do as they do in any industry: strike." It is a complete reversal of the usual desire for a "no-strike" clause by the company and the refusal of such clauses by the union.

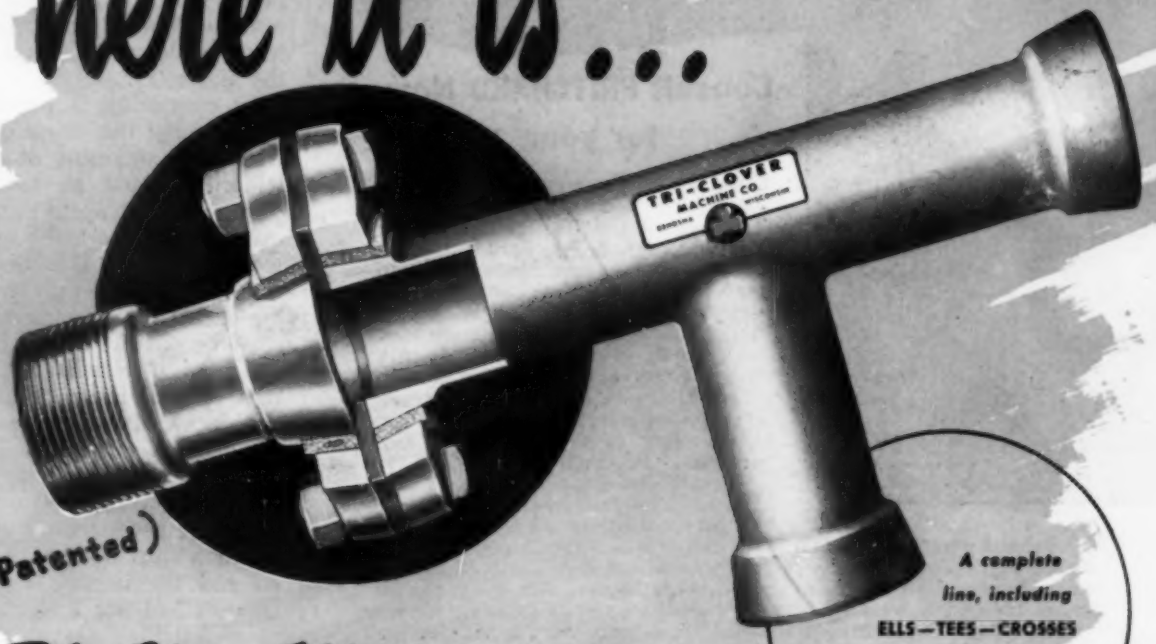
On non-occupational disability, the company, Carbide, proposes a three day waiting period, weekly payments for a period determined by seniority. Additional payments could come under an employee-participating group insurance plan. This is the plan in effect at the separation plants. The union wants to continue the old plan whereby benefits begin on the first day of illness, regular rates of pay are continued up to three months, and employees do not have to share the cost of the plan.

Vacation Plan

The current vacation plan at the laboratory, which the union wants to maintain, allows two weeks after one year of service and three weeks after two years. Carbide wants to substitute one week after one year, two weeks after two years, and four weeks after 15 years service.

The apprentice and training program conflict is based on traditional AFL concepts. The union contends that, like any AFL plant, there should

here it is...



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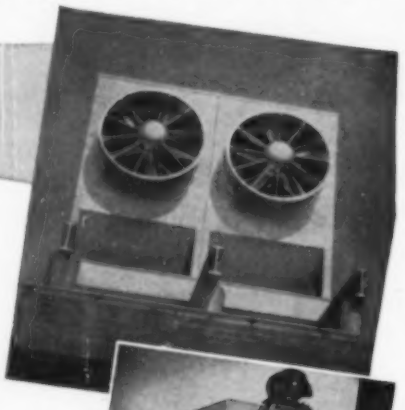

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be a fixed ratio of journeymen to apprentices. Carbide, seeing in this more apprentices than the laboratory itself needs, feels the AFL proposal would result in training craftsmen for "the whole wide world" rather than just the laboratory.

In considering a promotion plan, Carbide and the union differ on the traditional argument of how greatly seniority should be taken into account. The company wants to have qualifications the first point, seniority secondary. The union wants seniority first, qualification only considered to the extent that the person chosen by seniority must be able to do the work.

Such is the basis for the present Battle of Oak Ridge. There are other, smaller points of disagreement, but the above points are the major ones. How successful federal conciliators have been will be known on June 7 when the government's anti-strike injunction runs out. As May came to an end the impasse remained; conciliators had not budged either side.

ANOTHER Battle of Oak Ridge (and the other AEC plants) almost started recently over benefit plans. Over a year ago AEC began worrying over the standards of employment for scientific workers hired by AEC contractors. The battle preliminaries started with the appointment of a committee, headed by Dr. F. Wheeler Loomis of the University of Illinois, to study the subject. Nobody realized that the results could be a hot potato.

Anyway, the Loomis committee finished its report, and from it the AEC drafted a set of pay and working condition standards for scientifically trained personnel.

Scientists' Categories

On salaries, AEC split scientific workers into three categories, junior, associate, and senior scientists. Junior men would include men with bachelors and masters degrees doing research under supervision. Bachelors would start at $250 and go up by $20 jumps each year. Masters degree men would start at $270-290 and increase $25 each year. Associate scientists, doctors degree men capable of doing independent assigned work, would start at $350-400 and get an additional $30 for each year of experience. Senior scientists, experienced men capable of formulating and carrying out broad programs of research, would be paid from $550 up, with salaries above $1,000 per month being approved by AEC.

Benefit plans approved by AEC are liberal. They include a month's vaca-

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tion with pay, additional vacations for people exposed to unusual radiation hazards, freedom from time-clock punching, a system of retirement annuities with equity vested in the employee to facilitate transfers. Also included are payment of travel expenses to scientific meetings, payment for movement of families and household goods to permanent employees, and sick leave conforming to university practice. AEC believes in an opportunity for basic research, with some leading scientists in each laboratory freed from all "programatic" work.

The Loomis Committee's report, as such, didn't start any fireworks. But after AEC made out the set of standards given above, it was going to send them—very confidentially—to its area managers. Then the managers could use them as a guide in determining what costs of its contractors were reimbursable. Unluckily for AEC, somebody slipped, and the set of standards were circulated to the whole AEC mailing list. Then the howl went up—from the contractors.

Contractor Employees

AEC is carrying out its program through private contractors, trying to prepare for the time when atomic energy will be available for industrial use. The contractors have tried to be independent, doing their best to convince their atomic energy employees that they are contractor employees, not government workers. But the set of standards looked like an AEC move to take employee relations out of the hands of the contractors. If the contractor was not meeting the AEC standards, he had only three choices: change his entire personnel policies, atomic and non-atomic; set up the atomic energy employees as a specially favored group; or appear to be withholding from the atomic energy employees benefits that AEC was perfectly willing to pay for.

The contractors were approaching a boil when AEC withdrew the order, and the potential Second Battle of Oak Ridge was off. But it is an open secret that the rescinded standards still represent AEC policy.

In considering changes in its own employee benefit plans, each chemical company is going to have to watch AEC. As one of the largest employers of scientific talent in the United States, AEC's policies may well set a pattern that the chemical process industries will have to follow. The alternative will be to have scientific manpower clamor to work for those companies who have AEC contracts, where benefit plans are more liberal. Other companies will just have to toe the line.

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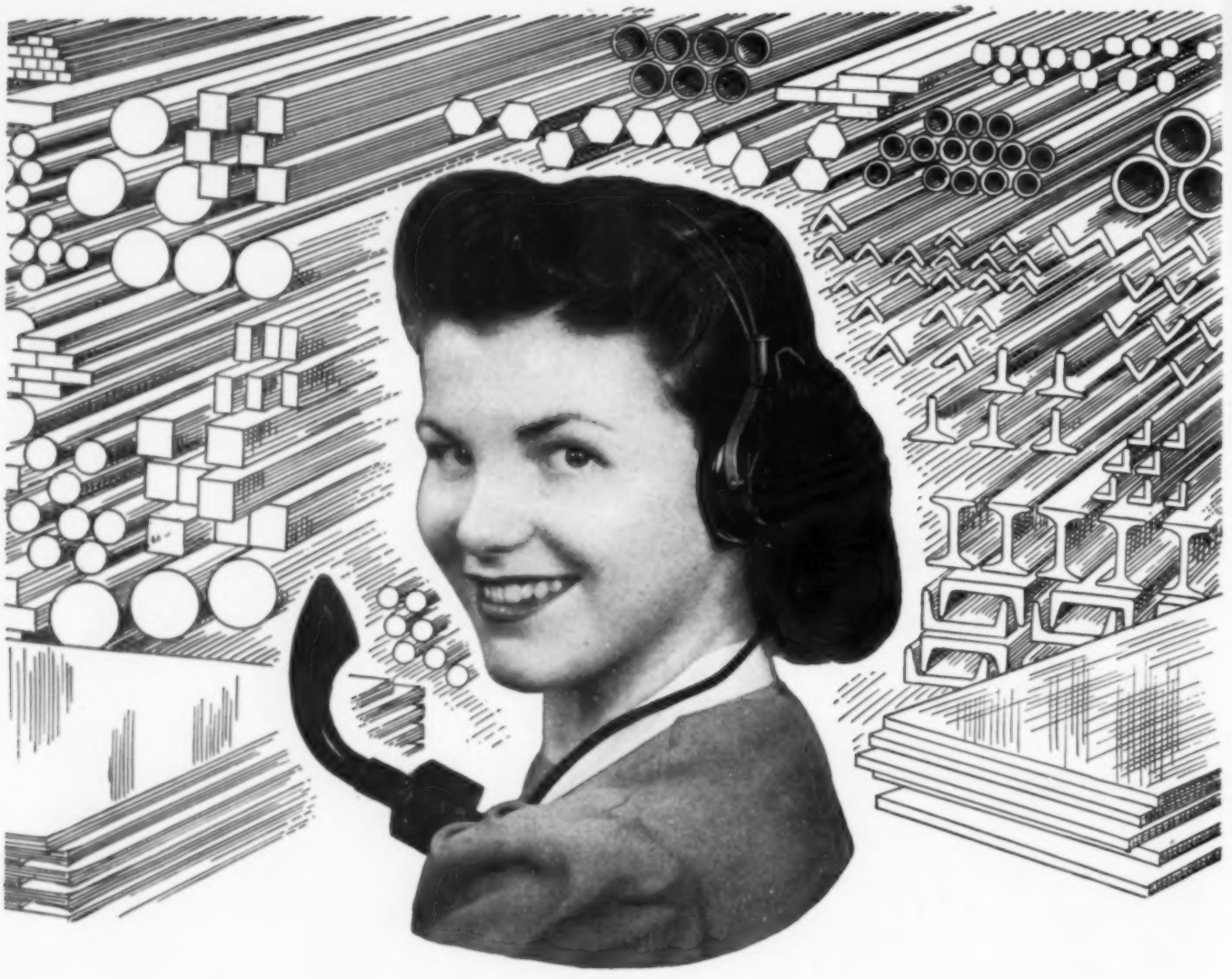

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CHEMICAL ENGINEERING NEWS

Richard F. Warren, ASSISTANT EDITOR

Linde Building a Large Oxygen Unit at Belle

USE of oxygen in production of synthesis gas from coke has been talked about ever since low-cost oxygen units became a practicality. The first large scale oxygen installation in the United States for this purpose has recently been announced by Linde Air Products and Du Pont. It will be a 360 ton oxygen plant to supply Du Pont's Belle Works, located outside of Charleston, W. Va., where synthesis gas is turned into ammonia, methanol, and other products. The oxygen unit will be located on Du Pont land, operated by Linde, and will produce about 9,000,000 cfd. of 95 percent oxygen. Construction, expected to be completed in 1949, will involve not only the building of the oxygen plant, but will also require modification of existing gas generator sets. Use of oxygen will mean continuous, rather than cyclic, operation of the water gas sets. Savings that justify the construction of the oxygen plant are expected in coke consumption, generator maintenance, and generator operating costs.

Diamond Houston Plant Starts Operations

NEW Houston plant of Diamond Alkali Co. got into the initial phases of production last month. Full operation is expected in July, at which time the plant will turn out each day 220 tons of chlorine and a proportional amount of caustic. A number of officials from company headquarters were in Houston for an open house meeting with employees of the plant and their families.

Golden Anniversary of Chemical Engineering at Michigan

Shown at the celebration held in Ann Arbor are (from left to right): I. C. Crawford, dean, College of Engineering; A. G. Ruthven, president, University of Michigan; W. H. Dow, Dow Chemical Co.; R. A. Hayward, Kalamazoo Vegetable Parchment Co.; A. H. White, former head of chemical engineering department; and G. G. Brown, present head of the department.

Munson Addresses MCA Annual Session Held at Skytop

SPEAKING at the annual meeting of the Manufacturing Chemists' Association at Skytop, Pa., on June 3, C. S. Munson, president of the association, said that an oppressive tax structure was drying up the source of investment capital now urgently needed in the development of the chemical industry. In part Mr. Munson said that the chemical industry now finds its tried and true sources of new money drying up, as taxpayers' surpluses are drained off by continuing prohibitive wartime taxes. At the same time the industry, like all others, needs far larger amounts of capital than formerly, because of the increased cost of building new plants and doing business in an inflationary economy, and also because of the greatly increased number of projects emerging from the research laboratories and needing new plants for their commercial manufacture.

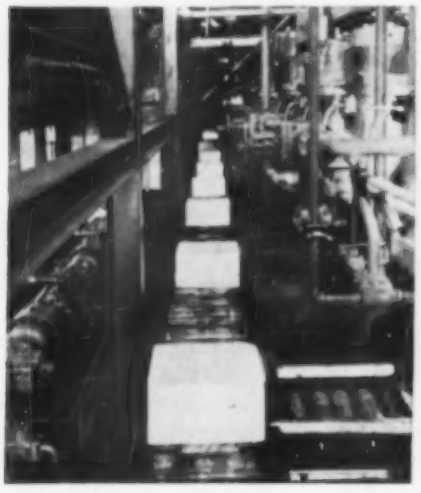
In 1947 the biggest single source of the new money was the industry's own profits. It is probable that this will again be the case in 1948. There are indications that chemical sales in 1948 will surpass the record high of 1947. Profits in 1948, however, may be well below the 1947 level, due to higher costs all along the line. In 1948 and 1949, the industry may be unable to contribute from profits the large amounts it has been plowing back into new plants and equipment in recent years.

The net investment (after depreciation) of the chemical industry in property, plants, and equipment is about $2,500,000,000. In terms of replacement costs, this might well run about $5,000,000,000, since a plant that cost $1,000,000 prewar would cost $2,000,000 or more today.

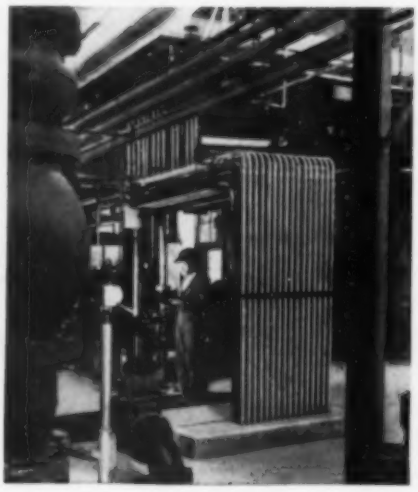
Investments in inventory are almost as heavy as in fixed plant. At the end of 1947 the chemical industry had about $2,000,000,000 tied up in inventory. This means that a large proportion of the industry's profits during and since the war is frozen in inventories. Prewar chemical industry inventories were about 10 percent of total assets; today they are 15 percent. Plant and inventory expansion has taken about all of the industry's reserves. It cannot tap these accumulated funds any longer for further necessary expansion. The ceiling has been reached in this respect.

The wide disparity between sharply increased costs and moderately higher

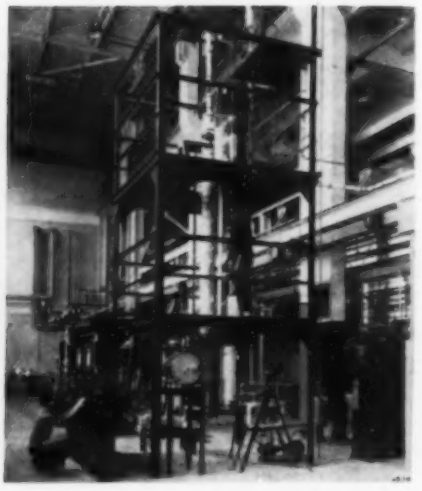
More New Plants For . . .



DRY ICE is coming from presses of expanded unit at Mathieson Chemical Corp.'s large Saltville, Va., plant



POLYVINYL CHLORIDE is produced at this Glenn L. Martin chemical division unit in Painsville, Ohio.



SYNTHETIC FUEL problems are studied at recently opened pilot plant operated by Bureau of Mines at Bruceton, Pa.

chemical prices has also imposed a financial ceiling on the industry. Wage rates have increased from the 1939 average of 78c. to a current $1.48 (supplementary employee compensation, largely for work not done, e.g., pensions, vacations, holidays, etc., adds an additional 5 percent to wage and salary payments). Raw material and fuel costs, which in 1939 amounted to about half of the industry's sales dollar, have increased substantially, as have the costs of containers, transportation, plant and office maintenance, advertising and other overhead items. As compared with 1939, the principal costs of the chemical industry, i.e., wage rates, commodity prices and construction costs have risen 88 percent, 81 percent and 86 percent, respectively. Prices, received by the industry, on the other hand, have not moved up in the same degree and are only 32 percent above the 1939 level. The increased costs of doing business today means that substantially increased amounts of working capital must be maintained by chemical companies. Still more funds will be required to handle any expansion in accounts receivable, third round wage increases, etc.

The ceiling has been reached in tapping undistributed profits and depreciation reserves of the wartime period which are now for the most part incorporated in expanded inventories and plant. The industry's current level of undistributed profits of about $500,000,000 does not constitute an adequate source of funds for expansion, nor will depreciation reserves, placed at approximately $200,000,000 yield the additional amount.

The following officers were elected at the annual meeting: President, Charles S. Munson, U. S. Industrial Chemicals, Inc.; vice presidents, Leonard T. Beale, Pennsylvania Salt Mfg. Co., and Harold O. C. Ingraham, General Chemical Co.; treasurer, J. W. McLaughlin, Carbide & Carbon Chemical Corp.; secretary, Warren N. Watson; executive committee, George W. Merck (Chairman), W. B. Bell, Wyly M. Billing, Walter B. Brown, W. S. Landes, Clyde D. Marlatt, William M. Rand, P. T. Sharples, John L. Smith, Wm. H. Ward and H. I. Young.

NYLON is one of the products developed at this Du Pont experimentation station. It is being expanded. Units left of line will be added to present center.

Du Pont Expanding Its Experimental Station

A $30 million expansion of research facilities at Du Pont company's Experimental Station at Wilmington has been approved by the executive and finance committees and submitted for ratification to the board of directors. This is the largest single laboratory project the company has ever undertaken. It will make the birthplace of nylon and neoprene one of the largest research establishments in the world.

Some of the company's research organizations now located elsewhere will transfer to the new facilities to be provided. Already at the station are laboratories of the chemical, engineering, Grasselli and ammonia departments, the nylon laboratory and the Haskell Toxicological laboratory. They will be joined by the Rayon Pioneering laboratory, by research personnel of the plastics and pigments depart-

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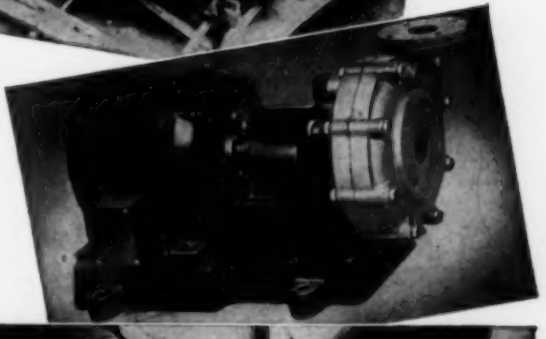
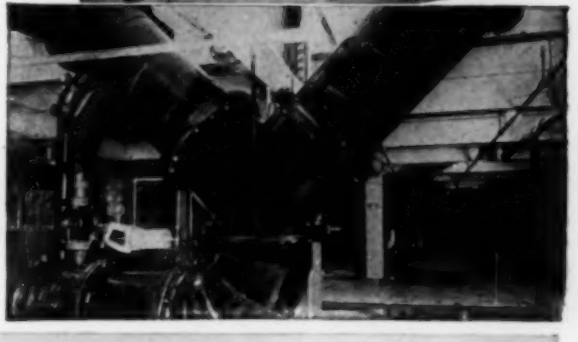
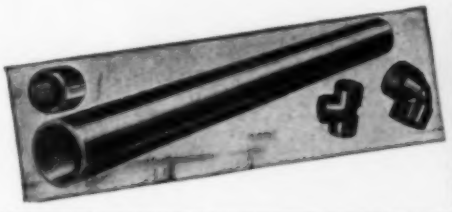
ACE hard rubber pumps, centrifugal and gear, single or double acting



All-rubber or rubber-lined pipe, valves, fittings, molded parts



ACE Saran tubing, pipe, fittings and molded parts



HARD RUBBER & RUBBER LINED PIPES & FITTINGS

RUBBER LINED VALVES

RUBBER LINED TANKS

ACE HARD RUBBER AND SARAN

RUBBER PROTECTED PUMPS

MOLDED HARD RUBBER AND SARAN

SPECIAL RUBBER COVERED EQUIPMENT

AMERICAN HARD RUBBER COMPANY · 11 MERCER STREET · NEW YORK 13, N.Y.

HOW— TWO MEN HANDLE MILLIONS OF GALLONS OF CHEMICALS ANNUALLY

These Bowser Xacto Meters are at work every day in a large Eastern chemical plant*. They enable two men to handle and account for several million gallons of commercial solvents, alkalis and acids every year.

The large scale operations of this organization would be costly without its efficient storage and distribution system which provides for the accurate measurement of every gallon of liquid.

With it, delivery and measurement of chemicals to the numerous processing centers become almost as easy as opening a valve. Waste is negligible and the entire inventory status can be determined any time on short notice.

Every Bowser product is designed to help industry do a better job . . . more economically. An experienced Bowser man will be glad to discuss the liquid handling problems of your plant. Write to Bowser, Inc., 1367 Creighton Avenue, Fort Wayne 2, Indiana.

*Name on request.

Automatic proportioner . . . for two or more liquids . . . with patented, precision volumetric meter control. Records quantity of each ingredient as well as finished product.

Automatic unit for filling containers in predetermined quantities from one pint to nine quarts. Temperature control and specific gravity adjustment.

Bowser Xacto Meters accurately measure liquids ranging from acids to wood oil. Gray cast iron, brass and bronze, or stainless steel construction.

BOWSER ESTABLISHED 1885

LIQUID CONTROL SPECIALISTS SINCE 1885

ments and by additional Grasselli department research activities. The number of chemists and other technologists at the station will be almost doubled when construction is completed.

Construction plans call for ten new laboratory and semi-works buildings for long-range research and development of new chemical discoveries. Existing laboratory buildings for nylon and other products will be enlarged. There are also to be thirteen new service buildings.

"The company's future will depend to a large degree upon entirely new products and processes flowing from investigations requiring a background of basic knowledge developed in the laboratory," Mr. Greenewalt, president, said.

Cochrane Receives Hyatt Award at White House

JOHN WESTLEY HYATT Award was presented to John D. Cochrane, Jr., in May. President Harry S. Truman presented the gold medal and one thousand dollar prize at a ceremony held in the White House last month. Mr. Cochrane is director of research and

CONVENTION CALENDAR

American Petroleum Institute, division of production, eastern district meeting, Greenbrier Hotel, White Sulphur Springs, W. Va., June 30-July 2.

Fifth National Chemical Exposition, Coliseum, Chicago, Ill., October 12-16.

American Petroleum Institute, annual meeting, Stevens Hotel, Chicago, Ill., November 8-11.

American Oil Chemists Society, fall meeting, Pennsylvania Hotel, New York, N. Y., November 15-18.

Western Packaging Exposition, San Francisco Civic Auditorium, San Francisco, August 10-13.

American Chemical Society, 114th national meeting, Washington, August 30-September 3.

American Association for the Advancement of Science, centennial meeting, Washington, September 13-17.

American Institute of Chemical Engineers, regional meeting, French Lick Springs, September 15-17.

Third Instrument Conference and Exhibit, Convention Hall, Philadelphia, September 13-17.

National Plastics Exposition, Grand Central Palace, New York, September 27-October 1.

USE OVERHEAD AIR HOISTS

Lifting and lowering operations over chemical vats, pickling, plating and washing tanks, heat-treat chambers, etc., call for a hoist with a motor that will give dependable performance regardless of a wet—hot—gaseous or dusty atmosphere.

You can put Ingersoll-Rand Overhead Air Hoists to work under practically any condition and know that there will be no time lost for repairs. Clean compressed air is piped into a completely sealed, piston-type air motor operating in a bath of oil. The exhaust air helps to improve the atmosphere.

Another valuable feature is the throttle control. A range of speeds from a smooth creep to full throttle is the answer to more output where accuracy and smoothness is required. Units are available from 200 to 20,000 lbs. capacity.

B-993

Ingersoll-Rand

FOR RELIABILITY IN HOT GASEOUS ATMOSPHERES

Write for the new bulletin,
Form 5020, *"Hoist and Haul with Air Power."*
Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.

COMPRESSORS · AIR TOOLS · ROCK DRILLS · TURBO BLOWERS · CONDENSERS · CENTRIFUGAL PUMPS · OIL & GAS ENGINES

TOLHURST

CENTRIFUGAL FORCE

Speed and Convenience in Processing

PHARMACEUTICALS AND FINE CHEMICALS

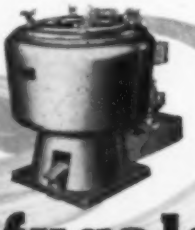
Do These 6 Jobs
Faster, More Economically
- FILTERING
- DRAINING
- DEHYDRATING
- CLARIFYING
- THICKENING
- SEPARATING

Centrifugal force, as Tolhurst applies it to processing problems, ranges anywhere from a few hundred to several thousand times the force of gravity. With Tolhurst Centrifugals greater speed, more convenience and economy are possible in processing pharmaceuticals and fine chemicals. Tolhurst "Center-Slung" models are ideally suited for such operations. Baskets are welded steel, monel, stainless steel, rubber-covered or made of other materials as specified. Perforate or imperforate baskets, with backing screens supplied if requested. Available in 30", 40" and 48" diameters with fume-tight covers and explosion-proof motors when ordered.

"SOLID CURB" CENTRIFUGALS Designed for plants having smaller batches of materials to be processed, Tolhurst "Solid Curb" centrifugals are built in 20" and 26" diameters. Also available with special baskets, backing screens, cover and motor equipment.

Laboratory Service Available

For confidential, unbiased and intelligent recommendations on your centrifugal problems, consult Tolhurst with its well-qualified staff and modern research facilities.



Write today for catalog and prices.

Tolhurst Centrifugals

Division of American Machine and Metals, Inc.

EAST MOLINE, ILLINOIS

In Canada: American Machine and Metals (Canada) Ltd.
215 St. James Street West, Montreal 1, P.Q.

development, Formica Insulation Co. He received the award for outstanding work in the development and continued improvement of commercially acceptable decorative laminates from condensation resins. As a result of his continued insistence on superior materials, melamine resins were modified for laminating purposes. Continued research by raw materials suppliers in cooperation with Mr. Cochrane resulted, in 1947, in a new and improved melamine resin suitable for solid color production.

Chemical Development Group Organized in Cambridge

To MEET specialized requirements the Chemical Development Corp. has been established at Cambridge, Mass. Gustavus J. Esselen is president and Albert M. Creighton, Jr., treasurer. Research, process development and manufacture of chemicals and chemical formulations are conducted on a confidential basis. Production can be started at once if the details of manufacture are known. If details are not known, the company is prepared to develop a full-scale and efficient process. If a project requires laboratory research, arrangements can be made with the company's affiliate, Esselen Research Corp., Boston. Work is done in close cooperation with the staffs of clients. Headquarters are at 100 Memorial Drive, Cambridge.

Mutual Chemical Building New Bichromate Plant

ACCORDING to George Benington, president, Mutual Chemical Co. of America, plans for construction of a new bichromate plant on property adjoining the company's present plant in Baltimore have been completed. The new facilities are scheduled for completion by the end of 1949 and will include additional capacity which, together with the existing facilities, should be sufficient to satisfy all likely demands and also provide improved working conditions and more efficient operation. Sanderson & Porter are the contract engineers.

Berkeley Campus Will Get Larger Atom Smasher

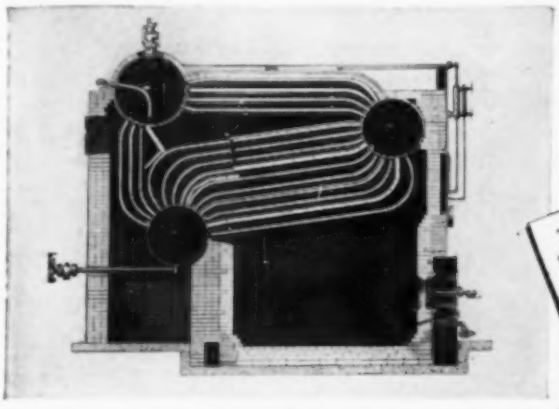
A NEW four-year contract for studies in nuclear physics and plans for a 110-ft. cyclotron, both at the University of California, Berkeley, have been announced by the Atomic Energy Commission. The contract extends that held by the University's radiation laboratory since 1943. It provides for operation of the 4,000-ton cyclotron,

B&W Integral-Furnace Boiler, Type FF, with completely water-cooled furnace, for high-duty power and process services.

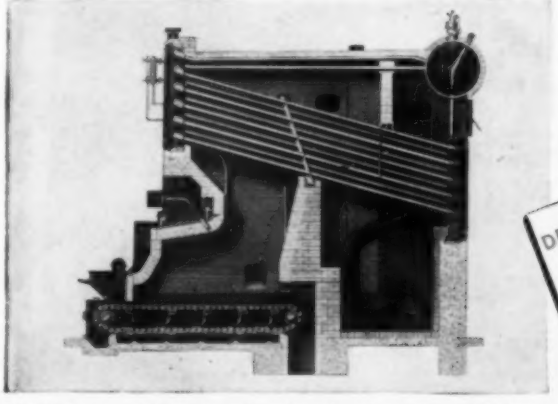
The B&W CUBS*...

three SMALL *boilers*

with three BIG *benefits*



Type H Stirling Boiler usually for low headroom installations where oil-refractory furnaces are suitable—water cooling may be added.



B&W Design 32 Boiler for low headroom installations where simplicity of straight-tube type is desirable.

In B&W Design 32, Type H Stirling, and Type FF Integral-Furnace Boilers, B&W offers a selection of *three* different units designed expressly for steam requirements from 10,000 to 60,000 lb. per hr. at pressures above 160 psi. Each has distinctive features that make it the best buy in boilers for specific service conditions, yet ALL three are outstanding for their compactness—maximum steaming capacity in minimum space; and for complete coordination of components into highly efficient units of simplified design and standardized construction.

Their high standards of performance, continuity of service, and long-term economy have won wide acceptance for these boilers for many years. In 1947, for example, orders placed for B&W CUBS* represented an aggregate steam capacity of over 2,900,000 lb. per hr.

ALL COMPACT—ALL COORDINATED ALL COMPLETE

* Compete Unit BoilerS

Each as much a package boiler as any unit its capacity can be.

G-387

FOR POWER PLANTS—B&W, Open-Pass, Radiant, Integral-Furnace, Cross-Drum, Stirling and Waste-Heat Stationary Boilers . . . Air Heaters . . . Economizers . . . Superheaters . . . Water-Cooled Furnaces . . . Oil, Gas & Multifuel Burners . . . Chain-Grate Stokers . . . Stacks and Breechings . . . Seamless & Welded Tubes for All Pressure and Mechanical Applications . . . Refractories . . . Chemical Recovery Units . . . Alloy Castings.

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OTHER B&W PRODUCTS—Marine Boilers . . . Pressure Vessels . . . Process Equipment

BABCOCK & WILCOX

THE BABCOCK & WILCOX CO.
GENERAL OFFICES: 85 LIBERTY ST., NEW YORK 6, N.Y.
WORKS: ALLIANCE AND BARBERTON, O.; AUGUSTA, GA.

no chemical can attack TEFLON

STYLE 101 PLASTIC PACKING

for pumps and valves

• *for example:*

Worthington Worthite Pumps installed in the Koppers Company handling fuming sulphuric acid, had to be repacked every two days using conventional packing. Since packing with TEFLON Style 101 plastic packing last December, there has been no need to repack.

• *what is it?*

No. 101 Plastic Teflon Packing is a non-porous packing having the 100% chemical resistance of pure Teflon. Thoroughly tested. Withstands temperatures from minus 80°F to 525°F. Style 201 same as 101, except mica is substituted for graphite. This style for stainless steel valves and pumps. We also make Teflon covered gaskets.

• *SO . . .*

wherever, whenever you have a nasty packing or gasket problem, call on

POWER PRODUCTS CO.

11 Broadway New York 4, N. Y.

Official Photograph U. S. Navy

NAVAL RESEARCH is carried on in new $8 million Michelson laboratory, Inyokern, Calif. Activity centers are: (1) Electronics, (2) explosives, (3) physics, (4) aerodynamics, (5) radar, (6) chemistry, (7) metallurgy, (8) heat-treating, (9) cafeteria, (10) machine shop, (11) weather room, (12) testing, (13) photo lab.

continuation of biological, photosynthesis and medical researches. Support will continue for construction and operation of the synchrotron, the linear accelerator and the 60-in. medical cyclotron.

Construction of the 110-ft. cyclotron will take about five years and cost some $9,000,000. Larger than any in existence or planned, it will accelerate protons to 6,000 Mev. The present 184-in. cyclotron will accelerate protons to 350 Mev.

Chemical Engineering Courses Started in Mississippi

FOUR options in the field of chemical engineering will be offered for the first time next fall by the University of Mississippi's School of Engineering.

VITREOSIL

CRUCIBLES DISHES • TRAYS

Immune to Extreme Chemical, Thermal and Electrical Conditions. Non-catalytic. Non-porous.

Vitreosil Crucibles permit the production of compounds of real purity; and do not absorb material. It is possible to wind Vitreosil Crucibles with wire for direct electrical heating. Made in glazed and unglazed finish.

Vitreosil Dishes for concentrating, evaporating and crystallizing acid solutions. Made in large and small sizes and types as required.

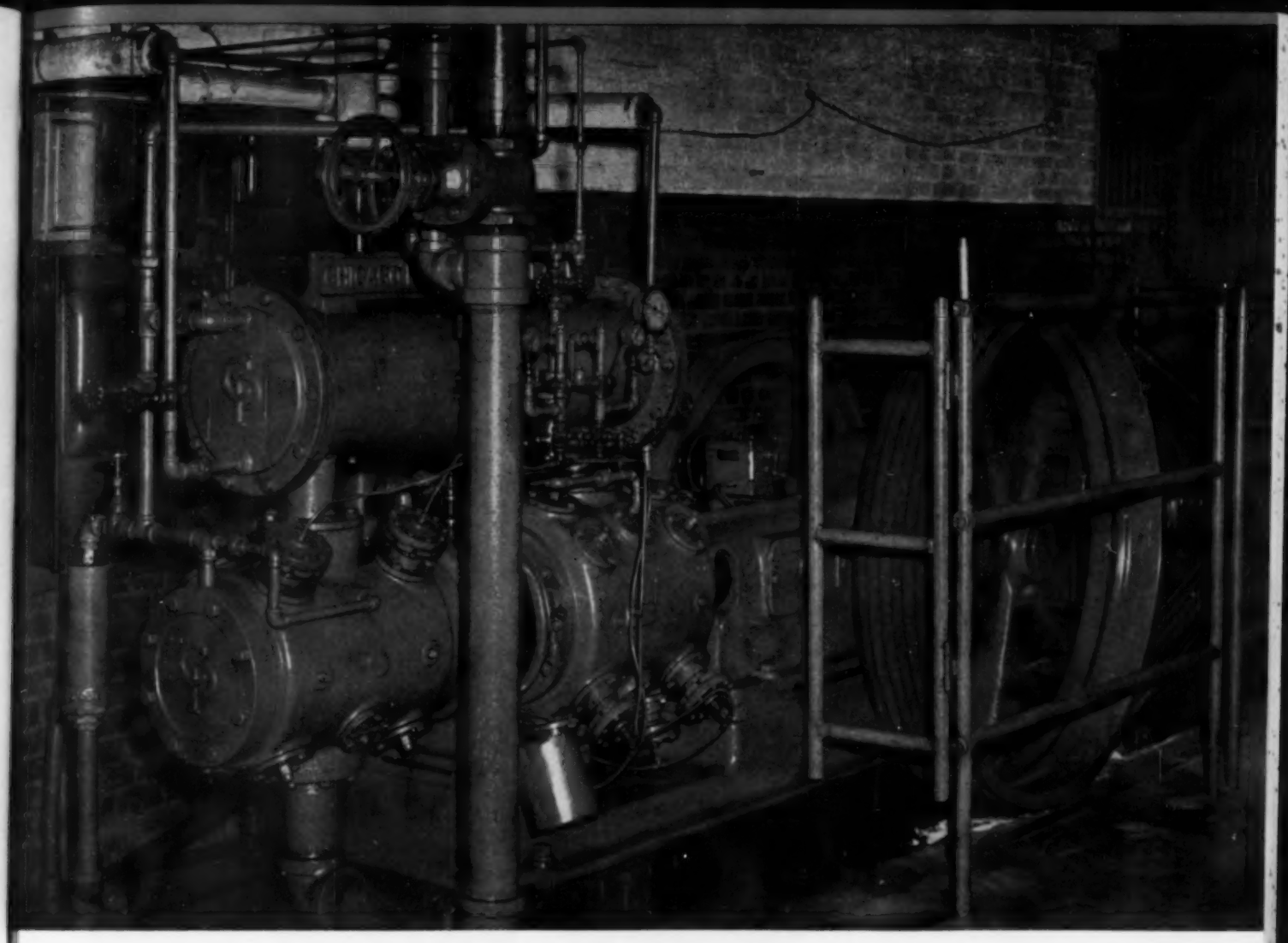
Vitreosil Trays are made in two types; four sided with overflow lip at one end for continuous acid concentration; and plain. Our Technical Staff places itself at your disposal for further data. For details as to sizes, prices, etc.,

VITREOUS SILICA — VITREOSIL REG. U.S. PAT. OFF. TRADE MARK

Write for Bulletin No. 8

THE THERMAL SYNDICATE, LTD.

12 EAST 46th STREET, NEW YORK 17, N.Y.



...and after that, no cleaning in 11 years!

A midwest pump manufacturer was having carbon-deposit trouble with the valves of the compressor shown above. Frequent cleaning was compulsory. Maintenance cost was high, compressor efficiency low.

"Make a test with Stanoil. Its high stabil-ty should lick your problem," said a Standard Oil Lubrication Engineer. The test was made . . . it has grown into 11 years of service (24 hours a day during the war) . . . and *no cleaning has been required in all that time!*

Clean operation with Stanoil results from its high stability plus an exceptionally effective oxidation inhibitor. Stanoil is a multi-purpose oil, that can replace many special and costly oils in your plant.

At the right are listed the principal types of equipment where Stanoil can save you money and maintenance time. A Standard Oil Lubrication Engineer will be glad to help you make a test. Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

For improved lubrication of . . .

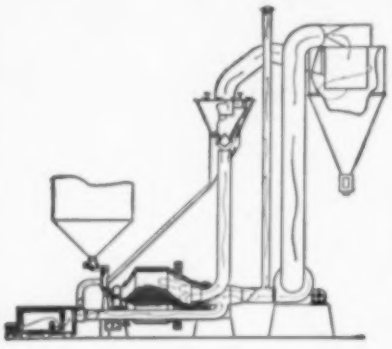
- **Compressors and Ice Machines**
- **Power Transmissions**
- **Hydraulic Turbines**
- **Gas Engines**
- **Steam Engines**
- **Steam Turbines**

STANOIL
Industrial Oil

STANDARD OIL COMPANY (INDIANA)

STANDARD

It
DRIES
while it
GRINDS
while it
CLASSIFIES



The
HARDINGE
"THERMOMILL"

The Hardinge "Thermomill" is an ingenious combination of Conical Mill, Reversed-Current Air Classifier, and Air Preheater. It dries, grinds, and classifies—in a single system—materials carrying an appreciable amount of surface moisture, reducing them to dry, finely-ground products. The need for a separate dryer is eliminated.

Write your nearest Hardinge office for information.

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COMPANY INCORPORATED
YORK, PENNSYLVANIA — 240 Arch St. • Main Office and Works
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PAPER and multiwall bags are produced at North Pensacola, Fla. New multiwall bag plant of Alabama Pulp and Paper Co. is in the right foreground. Its new mill is in left front. Florida Pulp and Paper Co. mill is in background.

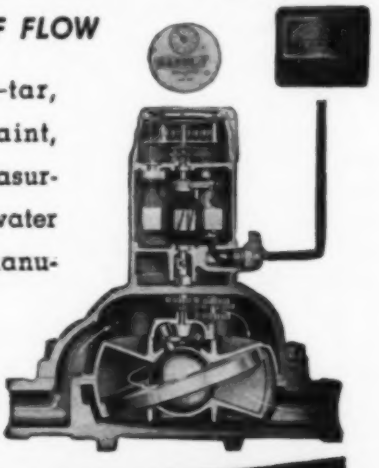
The curricula, set up by Dr. Lee H. Johnson, dean of the engineering school, and Dr. Frank A. Anderson, acting chairman of the department of Chemistry and Chemical Engineering, will offer options in technological, biochemical, administrative, and military chemical engineering. The technological option, for the general chemical engineering industrial workers provides the most technical training in chemistry and mathematics of all the choices. The biochemical option, one of the first of its kind in the nation, prepares the student for a career in food and drug processing, including a study of sanitation and bacteria control.

Jayhawk Ordnance Works Sold to Spencer

FINAL settlement was made during May for the sale of the surplus ammonia plant, Jayhawk Ordnance Works, to Spencer Chemical Co. for

NEW
HAYS Veriflow
TOTALIZING-INDICATING METER

Featuring
REMOTE INDICATION OF RATE OF FLOW



For practically all liquids—tar, molasses, crude oil, grease, paint, varnish, syrups, etc., etc.—for measuring, indicating, totalizing flow of water and chemicals in continuous manufacturing processes and numerous other uses. Its remote indicating feature is new—get the complete story.

SEND FOR BULLETIN. 46-766

The HAYS CORPORATION
COMBUSTION INSTRUMENTS AND CONTROL
MICHIGAN CITY, INDIANA, U.S.A.

I CAN IMPROVE *PROCESSING* SYSTEMS IN 5* WAYS!

"I am De Laval Centrifugal Force. I make possible cleaner, faster separation of two liquids (with a removal of solid impurities) or quicker and more complete removal of solids from a single liquid.

"I speed up processes because I make them continuous. The liquids that I separate are discharged from the De Laval centrifugal machine in a steady stream, and the solids that are thrown out of the liquids are stored out of the zone of separation until the bowl needs cleaning.

"Many different types and sizes of De Laval centrifugals enable me to be used to best advantage. The large 'Nozzle-Matic' models enable separations to be made at capacities up to 6,000 gallons per hour; the small Laboratory model makes efficient pilot plant separation work possible. The type of machine required is dictated by the nature of the liquids being processed. Write for additional information."

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

***Here They Are:**

SPEED PRODUCTION
SAVE LABOR
REDUCE PROCESSING TIME
IMPROVE PRODUCT
SIMPLIFY WASTE DISPOSAL

DE LAVAL
CENTRIFUGAL MACHINES
FOR *PROCESSING* SYSTEMS

For { LOWER COST... MORE EFFICIENT PUMPING
specify SIER-BATH ROTARY PUMPS
SIER-BATH SCREW PUMP
Advantages: • pulseless flow • anti-friction bearings • vibrationless operation • low maintenance cost • rugged construction.
Pumps: Acetate, asphalts, brines, Bunker C Fuel Oil, cellulosics, greases, molasses, syrups, lube oils, etc.
SIER-BATH GEAREX PUMP
Balanced Axial Thrust • Pulseless Flow • Vibrationless Operation • Roller Bushings for Precision Running under load.
Pumps: Oils, Varnishes, Solvents, Molasses, Chemical Solutions.
Capacities: 1-550 g.p.m.
Discharge: 250 p.s.i. for medium or high viscosities. 50 p.s.i. for water.
MADE BY ROTARY PUMP SPECIALISTS

SIER-BATH Screw Pumps and Gearex Pumps are made in a plant keyed to precision methods of gear manufacturing. Our engineers have a long background of experience specializing in the design of rotary pumps. As a result, the high quality of these pumps enables them to operate for long periods without maintenance. Their pulseless flow and vibrationless operation mean less wear on valves, couplings and other fittings. Pipes and joints remain tight. In every way, the Sier-Bath Screw and Gearex Pumps are constructed to render reliable and continuous service, with least possible maintenance. Write for detailed information.

ALSO MAKERS OF SIER-BATH PRECISION GEARS

FOUNDED 1905 **MEMBER A. G. M. A.**

Sier-Bath GEAR and PUMP CO., Inc.

9259 HUDSON BOULEVARD • NORTH BERGEN, NEW JERSEY

$11,000,000. This is the synthetic ammonia plant built by Military Chemical Works, the predecessor of the present purchaser, and operated for the Army throughout World War II.

The present purchase settlement replaces a long-term operating lease and constitutes an exercise of the option to buy which the company had under that contract. The company has expended substantial sums on new facilities, so that the plant is at present equipped to manufacture nitric acid, agricultural fertilizer solution, aqua ammonia, and dry ice, in addition to the anhydrous ammonia for which it was originally designed. Further expansion and diversification is contemplated, according to the company. The only restriction on the corporation operations is the national security clause in the sale contract. This provides that the present potential capacity of the plant for production of anhydrous ammonia will be maintained, to be available to the government in event of new military emergency.

Nobell Opens First Western Synthetic Phenol Unit

PHENOLIC molding powders and liquid resins are now being made in the expanded $250,000 plant of Nobell Resins Co. at Azusa, Calif. Because of the shortage of phenol, the firm has been forced to produce part of its phenol raw material requirements. Albert Nobell, president, is usually considered one of the pioneers in the West's resins and plastics industry. The plants have several unusual process features.

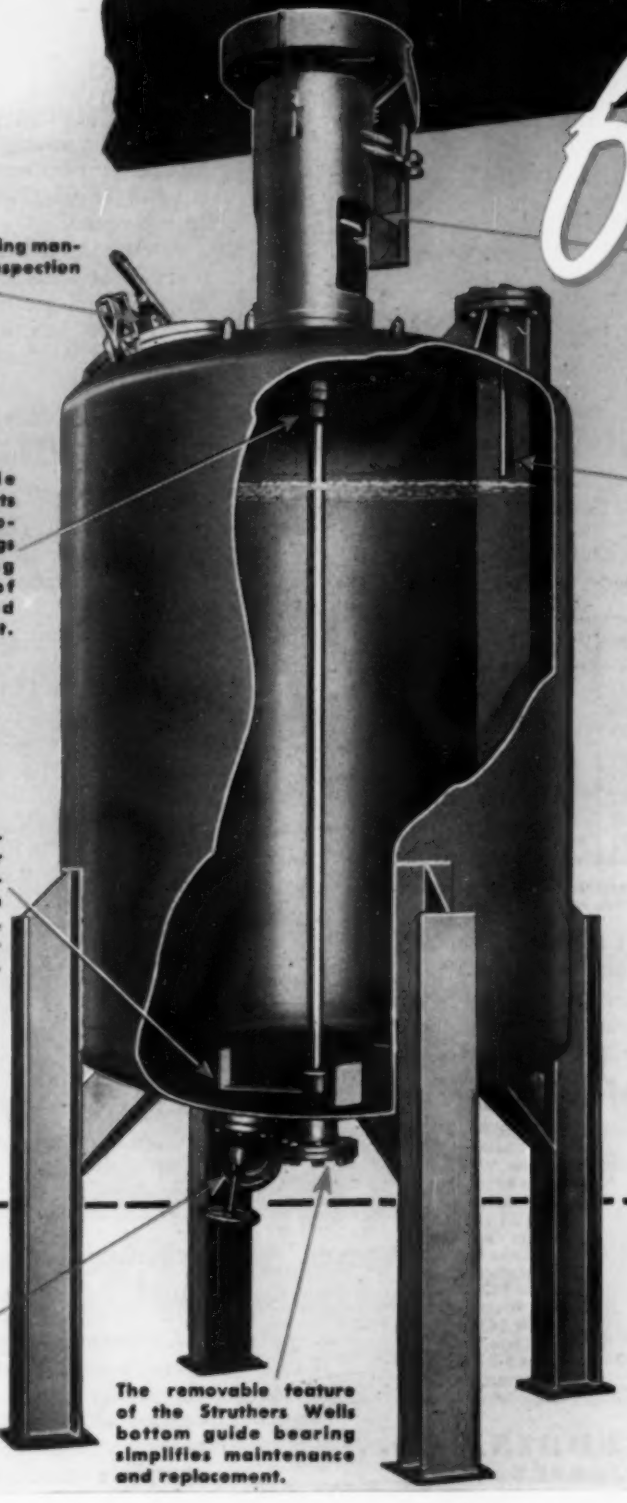
The phenol unit has a capacity to supply about 50 percent of the company's needs for resin production. In spite of the small output, low overhead and other economies are expected to permit economical operations. The plant is constructed in the open and spread out to minimize dangers from fire and fumes. George E. Smalley, works manager and chief engineer, is credited with designing and supervising construction.

Atomic Patent Rules Tentatively Set

EARLY in May Atomic Energy Commission first published formally its proposals for rule making regarding procedure in the applications for royalty fees or other compensation for patents, inventions, and discoveries. Following publication in the May 8 Federal Register, these proposed rules were subject to criticism and comment for a period of 30 days, which period ex-

Struthers Wells

RADIAL PROPELLER AGITATOR *features*



Quick opening manhole for inspection or filling.

A complete range of agitator drives is offered in ranges of speed from 10 RPM to 500 RPM; from fractional to 50 H.P. with stuffingboxes and mechanical seals for pressures up to 500 pounds or more.

Semi-flexible coupling protects the shaft supporting bearings from bending movements of the extended agitator shaft.

Vertical baffles may be supported by means of a nozzle in the top head thereby eliminating pockets in which materials may accumulate and providing easy outside adjustment.

The radial propeller agitator is simple in design, efficient in performance, and self-cleaning in operation.

Struthers Wells flush bottom valves are available in several sizes in all commercial alloys.

The removable feature of the Struthers Wells bottom guide bearing simplifies maintenance and replacement.

Struthers Wells Laboratories are equipped with mixers ranging from 5 gallons to 1,000 gallons in capacity which are available to determine your specific requirements.

STRUTHERS WELLS CORPORATION

Process Equipment Division

WARREN, PENNA.

Plants at Warren, Pa. and Titusville, Pa.

DE LAVAL GEAR REDUCERS *in* STOCK

CRATED FOR IMMEDIATE SHIPMENT

WG-22

These popular units are assembled, crated and ready for immediate shipment.

Reducer	Ratio	Probable *HP Motor	Reducer	Ratio	Probable *HP Motor
BW400	9⅔	5	BW600	11⅔	10
BW400	19½	3	BW600	19½	7.5
BW400	25	2	BW600	25	5
BW400	40	1.5	BW600	40	3
BW500	11⅔	7.5	BW700	9⅔	15
BW500	19½	5	BW700	19½	10
BW500	25	3	BW700	25	7.5
BW500	60	1.5	BW700	40	5

** Based on 1750 rpm—A.G.M.A. Class 1 Service. For other rpm's or Service refer to De Laval rating tables.*

Other sizes and ratios, in both single and double reductions, and in vertical and horizontal drives, also can be furnished promptly.

PHONE FOR QUICK SERVICE TO THESE

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Pittsburgh, Pa. Court 5400
Rochester, N. Y. Stone 6950
St. Paul, Minn. Garfield 1836
Salt Lake City, Utah Salt Lake City 3-7933
San Francisco, Calif. Sutter 3426
Seattle, Wash. Elliott 3437
Tulsa, Okla. Tulsa 5-2151
Washington, D. C. National 9238

DE LAVAL STEAM TURBINE CO.
TRENTON 2, NEW JERSEY

pired early in June. AEC is currently proceeding to review the comments received.

AEC announced also during May that it was appointing the Patent Compensation Board provided for in the Atomic Energy Act. This Board will review all applications from individuals and corporations seeking compensation. Hearings will be held in accordance with the standard Government procedure. After argument and briefs, the Board will prepare first findings to which interested parties may file objection. At the end, the Board will render a final decision as to reasonable royalty fees or other compensation.

In view of the necessary security restrictions, it is contemplated that many, perhaps most, of the proceedings will be strictly confidential. But AEC executives express the hope that satisfactory findings will not thereby be prevented.

Any parties interested in the general practice or specific cases are invited to communicate with the General Counsel of Atomic Energy Commission at the Washington headquarters.

Humble Erecting Plants in Texas and Louisiana

HUMBLE OIL & REFINING CO. expects to spend $12 million this year in continuation of its gas conservation program in Texas and Louisiana. New units to be built are natural gasoline plants near Conroe and Pickton, Tex., and Opelousas, La. Gas injection plants will be constructed at Kelsey and Seeligson, Tex. The Seeligson installation will later become a natural gasoline plant.

The $2.8 million unit at Opelousas will absorb condensables from wet natural gas passing through the Interstate Gas Co.'s pipe line. At Conroe the $4 million gasoline plant is designed to remove and recover a high percentage of propane in addition to butane and heavier hydrocarbons. The $2 million absorption-type natural gasoline plant at Pickton will return residue gas to the underlying sands for further recovery of crude. The three gasoline plants will process about 150 million cu. ft. of gas daily and produce from it about 4,800 bbl. of liquid hydrocarbons.

Arkansas Cooperative Will Build Superphosphate Unit

CONFIRMING an earlier unofficial decision the Arkansas Farm Bureau Cooperative voted at its annual convention at Little Rock last month to build and operate a $400,000 superphosphate manufacturing and fertilizer

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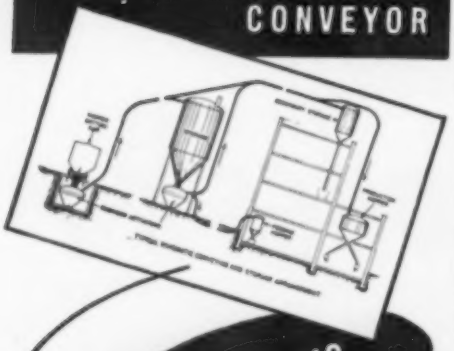

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SPEAKERS at the recent session of southern AIChE student chapters at University of Florida were (from left to right): Dr. W. H. Beisler; Dr. A. N. Newman, president of AIChE; Dr. R. A. Morgan, Dean J. Weil, University of Florida.

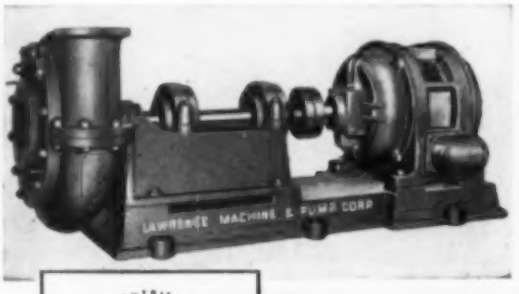
mixing plant. Present plans call for a plant to produce a minimum of 15,000 tons per year and distribution of the product within a 100-mi. radius. Location of the plant will be determined.

Soda Recovered from Natural Deposits in Nevada

FULL-SCALE commercial operations by Nevada Chemical Co., a subsidiary of Florida Pulp & Paper Co., will soon be getting under way at Rhodes marsh, eight miles south of Mina, Nev. According to reports, some 500 tons of anhydrous and crystalline sodium sulphate will be recovered daily from natural deposits. Cost of the project is said to be several hundred thousand dollars. Products are reportedly going to three large pulp and paper firms.

A source of sodium products before 1900, Rhodes marsh was later deprived of economic value by the inflow

How to CUT THE COST OF PUMPING An Abrasive Crystal SLURRY



In this installation wear was unavoidable. To keep costs down wear had to be minimized, so Lawrence engineers designed a replaceable lining of extremely hard alloy. The impeller was made of the same material. The horizontally-split construction permits quick, easy removal of the lining and facilitates repairs and replacements. The net result is low cost pumping. This same method can be adapted to the handling of any highly abrasive sludge, slurry, or mixture. We'll be glad to discuss it with you — without obligation.

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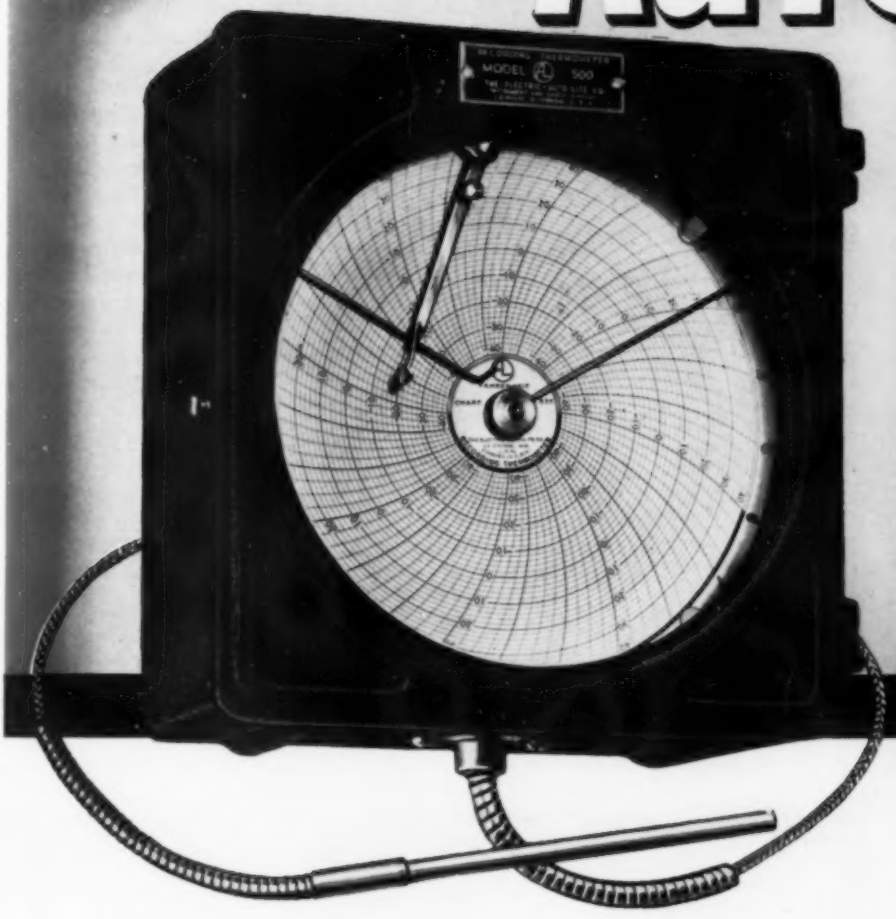

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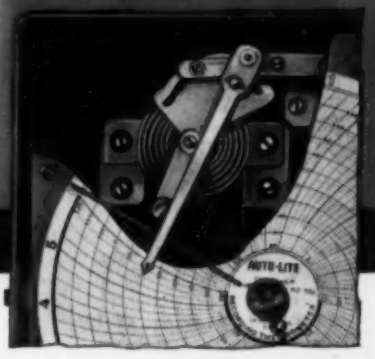

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GEO. A. HILL, JR., President

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of irrigation water. Present operations will mine the raw sodium sulphate by dragline. As one pond is scooped out, water will be pumped into it from the pond currently being worked. After crushing, the product is purified in a classifier and dried in a 120-ft. rotary kiln similar to those used in the cement industry. President of Nevada Chemical Co. is General Jarmon. Henri Withington is chief chemist and in charge of operations.

Oregon Laboratory Developing New Charcoal Process

Work on developing a commercially feasible process to produce charcoal, gas and tars from Douglas fir sawdust is definitely encouraging. So states J. D. Ross, research engineer at Oregon Forest Products Laboratory, Corvallis. A pilot plant to produce one ton of charcoal each 24 hr. will soon be constructed; the product will be used for large-scale testing by electrometallurgical, chemical and other industries. So far, the char has proved acceptable for a number of uses. If commercialized, the process may become a major step toward the upgrading of the large volumes of fir sawmill wastes in the Northwest. Research on the problem has been under way at the laboratory since 1943.

The pilot plant will have a rotary drier, rotary retort, char storage facilities, milling and pressing machinery and a briquet calcining oven. The retort will be 2 ft. in diameter and 20 ft. long, externally gas fired, with an integral char cooler at the discharge end. Char will be mixed with a binder and briquetted either with a Belgian or extension press. The briquets will be dried or, for metallurgical use, calcined at high temperatures in a horizontal tube oven. Temperatures in the retort range from 350-1,250 deg. F. Retention time is about 25 min.

Sawdust with a moisture content of less than 15 percent wet basis will give a char of about 88 percent fixed carbon, 9-9.5 volatile combustible matter and 1.9 percent ash. One pound of dry wood produces about 6.5 cu. ft. of 420-Btu. gas. Average yield by weight of products has been 38 percent pyroligneous acid and soluble tars, 35 percent gas, 23 percent charcoal and 4 percent settled tar.

Socony-Vacuum Will License Ethylene Process

Socony-Vacuum Oil Co. will license a new process, Thermofor pyrolytic cracking, for the production of ethylene and other unsaturated hydrocarbons as well as aromatic com-

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A type B PNEUMIX AGITATOR installed in 500 gallon crocks to mix acids.

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pounds. Developed by the company at its laboratories in Paulsboro, N. J., the process involves thermal cracking of low grade petroleum and residual oils. Rapid vaporization and cracking is accomplished by use of a moving bed of inert granules which pass through a continuous cycle of heat transfer and reheating.

Socony has authorized Vulcan Copper & Supply Co. of Cincinnati to design and build the new type of unit, and will furnish research and advisory assistance to licensees.

Lion Enlarging Ammonia Output at El Dorado

LION OIL CO. plans to increase the capacity of its anhydrous ammonia facilities at El Dorado, Ark., from the present production of 430 tons per day to 570 tons. The company will spend about $3.5 million for this expansion and for the construction of additional pressure storage tanks to handle the increased output.

Chemical Construction Corp. will design and construct the additions. Process engineering work is under way. Construction is expected to begin in a few weeks and to be finished early in 1949.

Fluor Corp. Sets Up New Division in Houston

A NEW division of The Fluor Corp., the Mid-Continent Gas-Gasoline Division, has been established, with headquarters at Houston. The division will handle engineering, drafting, purchasing accounting and construction in connection with gas-gasoline, cycling and dehydration plants east of the Rocky Mountains. Fluor has named Ernest Moncreif, office manager; J. L. Tathwell, engineering department; William F. Chapin, process department; Tom H. Hanks, accounting department; and C. E. Richardson, purchasing department.

California Lignite is Base Of New Process Industry

ONLY commercial plant in the United States to extract wax and pigments from lignite coal was recently put into operations at Ione, Calif., by American Lignite Products Co., a division of DeAngelis Coal Co., Carbondale, Pa. Present products are montan wax, sap brown dye and Van Dyke brown pigment. The single unit now in commercial production will be expanded in the near future. A fuel briquetting plant is already being set up.

Lignites are obtained from several

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The smooth, cushioned closing of Chapman Tilting Disc Check Valves is based on the design of the balanced hinge-pinned disc. When the valve is open, the disc rides evenly in the flow. On closing, the disc seat drops into contact with the body seat *easily* and *quietly*—cushioned by the effect of the stream against the short flap. Vibrations and destructive stresses in pipe lines are thereby reduced.

With this unique check valve, maintenance costs are cut, and head losses are reduced as much as 65% to 80% over those experienced with conventional type check valves.

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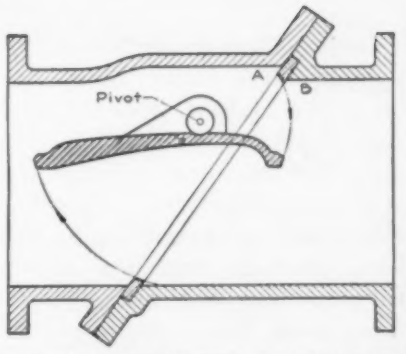

Cross-section of the Chapman Tilting Disc Check Valve illustrating the way that the balanced disc is supported on the pivot, with arrows showing the travel of the disc. A feature of the design is that the disc seat lifts away from the body seat when opening, and drops into contact when closing, with no sliding or wearing of the seats.

The Chapman Valve Manufacturing Company

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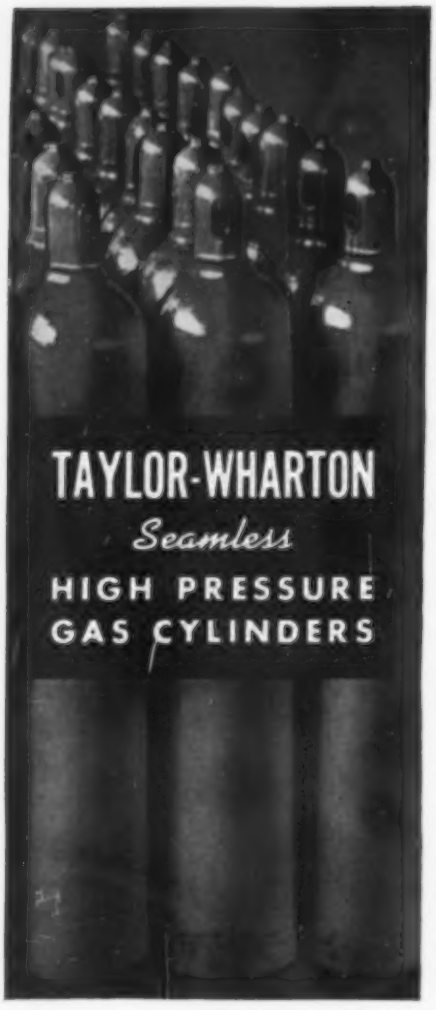

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deposits near Ione and Buena Vista. The process consists essentially of a solvent extraction system, using a combination of solvents, to obtain the primary products. These are separated and purified by a secondary extraction. Spent lignite, after a clean-up treatment, will be briquetted for fuel. For proper wax and color extraction, the lignites must be of a certain geologic form or age. Experimental work has indicated that the California lignites produce a better wax than those studied from Arkansas and other states. They also appear to be more nearly like the German deposits that gave the highest grade wax.

News Briefs

Lever Brothers Co., is building a new fatty acid and glycerine unit in Hammond, Ind., Construction work has been started. The unit will hydrolyze fats and oils in a continuous high pressure tower. The fatty acids will be refined and used by the company. Refined glycerine will be used in explosives, resins and cosmetics. Blaw-Knox Co. will erect the plant.

Chemical engineering division, ASEE will hold a course for chemical engineering teachers at University of Wisconsin, Aug. 29-Sept. 4.

READERS' VIEWS AND COMMENTS

Further Clarification Needed

To the Editor:

Sir:—I should like to call attention to a statement in Professor Larian's article on "Clarification of Distillation Terms" in your March issue (p. 116) which I feel needs further clarification. Professor Larian makes the assumption that a bubble tray with three (or any other number) rows of bubble caps producing perfect contacting will attain a separation equivalent to the same number of steps on a McCabe-Thiele diagram. Unfortunately, so great a separation can not be accomplished. The difficulty is that each cap row handles only a fraction of the total vapor flow, making it erroneous to apply the material balance equation for the tray as a whole (or operating line) to a single cap row, however perfect or imperfect its action may be.

If Professor Larian were correct, a perfect 70-tray column with 10 cap rows per tray would be equivalent to

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- Magnetic Permanence GUARANTEED FOR LIFE!

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Melting points range from 20° to 100° C. Readily soluble in petroleum and coal-tar (aromatic) solvents.

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Used in manufacture of adhesives, concrete curing compounds, electrical insulation, floor tile, linoleum, paints and varnishes, pipe coatings, textile coatings and in compounding of natural and synthetic rubber.

Melting point between 105° and 120° C. Soluble in aromatic solvents and partially in petroleum solvents.

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Used in the manufacture of adhesives, box toes, ethyl cellulose lacquers, impregnations, linoleum, floor tile, sealing compounds, varnishes and in the compounding of natural and synthetic rubber.

Melting points range from 80° to 135° C. Soluble in aromatic solvents. They are cohesive and have high molten viscosity.

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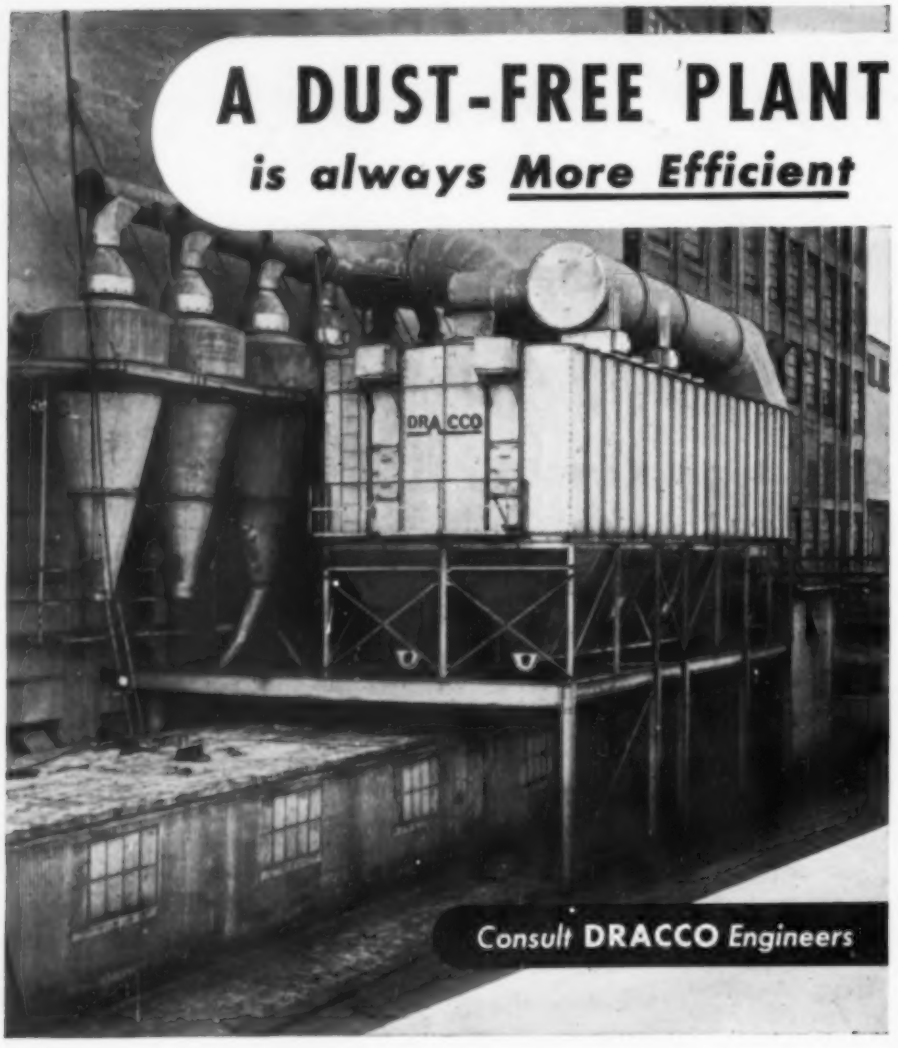

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700 steps on the McCabe-Thiele diagram. This terrific performance is not approached by commercial equipment, even if allowance is made for imperfect contacting by each cap row.

The theory of cross-flow enrichment is considerably more complex than might be gathered from the article. The treatment for binary systems has been ably set forth by W. K. Lewis, Jr. (*Ind. Eng. Chem.* **28**, 399, 1936). Lewis also defines the various efficiencies clearly and points out that the relationship between Murphree tray efficiency and over-all efficiency is

$$E_o = \frac{\ln [1 + E_{mv} (\lambda - 1)]}{\ln \lambda}$$

in which E_o = over-all efficiency; E_{mv} = Murphree tray efficiency; λ = ratio of the slopes of the equilibrium and operating lines on the y-x diagram.

STANLEY MARPLE, JR.
Shell Oil Co., Inc.,
Houston, Tex.

Clarification

To the Editor:

Sir:—The concept of a theoretical or perfect plate is one where there exists a complete mixing of the liquid on the plate so that the liquid overflowing the plate is of same composition as the liquid on the plate, and at the same time in equilibrium with the vapor rising through the plate. No consideration is given to the fact that a plate may consist of a series of contacts in the path of the liquid moving from the point of entry to the point of overflow. Accordingly, whether the plate offered an opportunity of one contact or more to the liquid, the change in the liquid composition for a perfect plate is considered to be given by one step on the Thiele-McCabe diagram.

This writer attempted to show that each step should be considered as representing one perfect plate consisting of one perfect contact unit. Based on mathematical as well as physical analysis, this concept of a perfect plate is more reasonable, because the condition of perfect mixing on a plate is approached when the plate can be considered as consisting of one contact unit. When several contacts are placed in the path of the liquid, the development of a liquid gradient is unavoidable. Since a plate is of large diameter and provides several contacts in the path of the liquid, the change in composition obtained will be greater than that which can be obtained from a single contact or from a complete mixing plate. In other words, compared with the performance of a complete mixing plate or of a plate with a single contact, a plate of several con-

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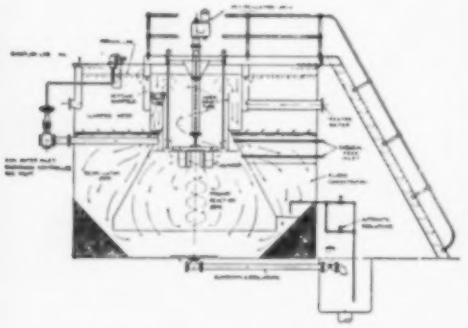
COMBINING the basic elements of equipment for mixing, floc formation, settling and thickening in a single reaction vessel, the Cochrane Rapid Reactor permits chemical reactions and separation of coagulated solids in only a fraction of the time necessary in intermittent cold process softeners. When the chemicals are added to incoming water, recirculated sludge seeds the precipitation and accelerates the chemical reactions.

COCHRANE RAPID REACTOR



Showing progress of raw water, addition of reagents, recirculation arrangements, and method of collection of clarified effluent.

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Simple compact design.

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Conservative in floor space and head room.

CONSISTENCY OF TREATMENT
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tacts will have a greater efficiency. If a complete mixing plate (single contact plate) is considered perfect and correspondingly of 100 percent efficiency, the plate of several contacts may actually have an efficiency greater than 100 percent, even when the contacts are not perfect. Lewis, and others before him, has recognized this fact and, making certain simplifying assumptions, derived mathematical expressions for predicting the overall plate efficiency for different local contact efficiencies and for different flow arrangements. He has shown that the best arrangement is when the liquid is always flowing in the same direction. This arrangement is, to a great extent, simulated by plates of several contact units placed in the path of the liquid. It will, however, be observed that plate efficiency greater than 100 percent is a relative efficiency.

The question is raised concerning the equivalence of each perfect contact unit on the plate of several contacts to a step on the Thiele-McCabe diagram. If it is specified that the plate should perform in a manner so that a definite change in composition of the liquid would take place, it will require a certain number of contacts to do so. From a material balance on the more volatile component between the terminals of the streams, it is shown that the operating line of the plate coincides with that of the column itself. Therefore, there is reason to suppose that for each perfect contact the points representing the equilibrium state will be on the equilibrium curve and the points representing the compositions of liquid and vapor passing each other will be represented by a point on the operating line, even though only a fraction of the total vapor comes in contact with the entire amount of liquid at the particular contact. The operating line is the locus of such points.

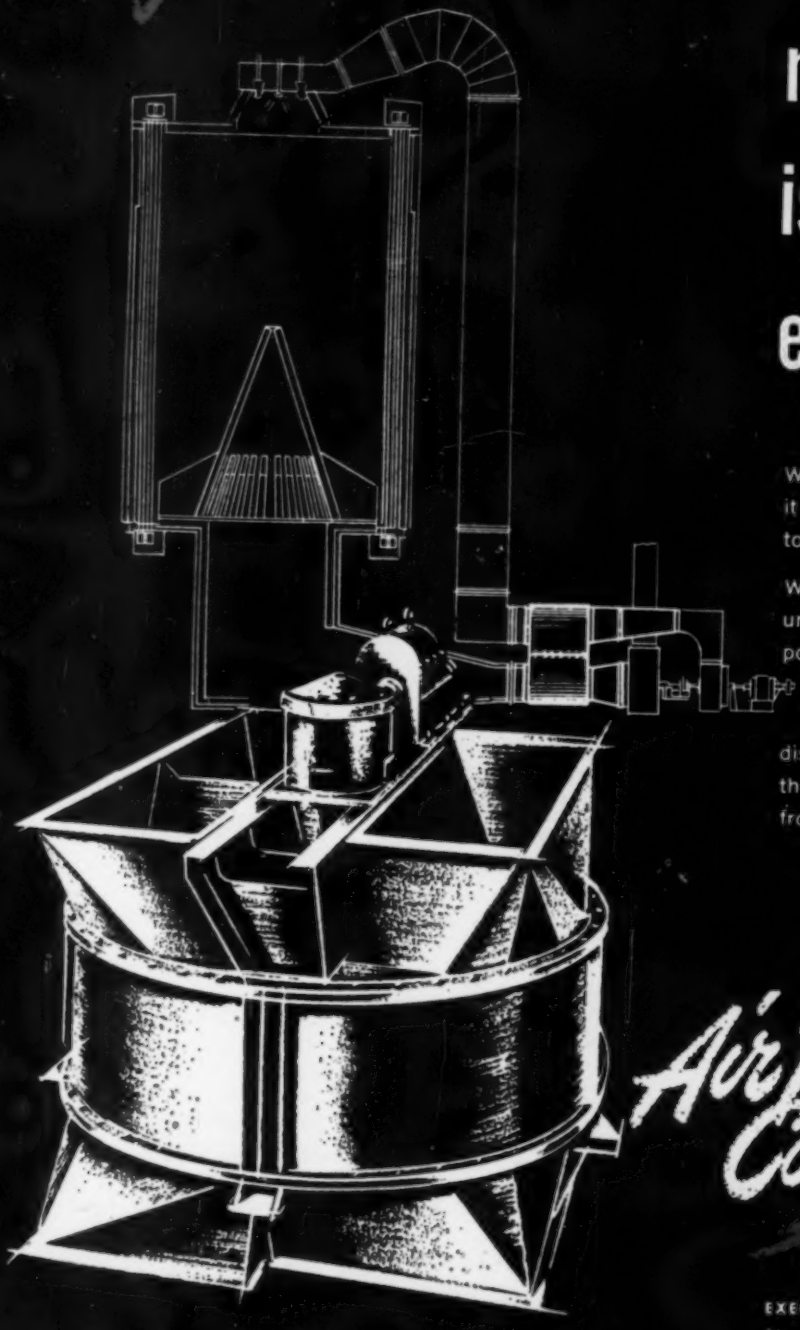
The number of perfect plates required for a given separation will depend on the binary system and the conditions specified. Although not common, still there are cases where the number of perfect plates may reach several hundreds—e.g., 427 in the separation of oxygen isotopes by the distillation of water (Urey and Huffman, *Ind. Eng. Chem.* **29**, 531, 1937). Such cases need not be handled by graphic method, as the analytical method of Dodge and Huffman (*Ind. Eng. Chem.* **29**, 1,434, 1937) gives results in excellent agreement with observed values.

M. G. LARIAN

Michigan State College of Agriculture & Applied Science, East Lansing, Mich.

Designed for Preheat

when high heat recovery is essential



With the Ljungstrom Air Preheater, it is practical to push heat recovery to the limit.

While plans for cracking stills are under consideration, investigate the possibilities of the Ljungstrom. The specialized experience of Air Preheater engineers is at your disposal, to aid you in effecting the most economic heat recovery from flue gases.

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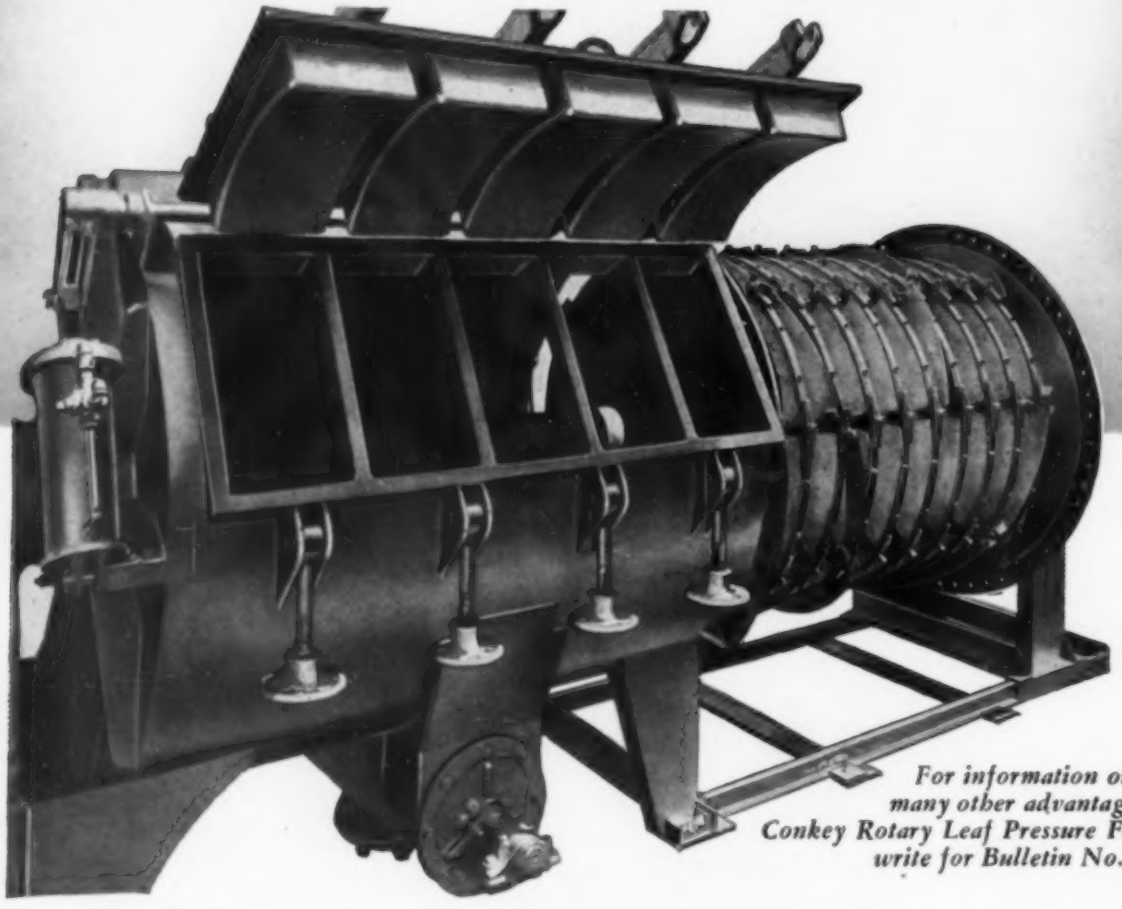
When you install the new Conkey Rotary Leaf Pressure Filter you need allow no more than normal working space around your filter. Air cylinder actuated doors on the new Conkey allow complete access to the filter leaf element for inspection, redressing or quick removal and replacement of any leaf sector, without disturbing any other sector.

Complete removal of the entire filter element — if the necessity ever arises — is accomplished merely by unbolting the valve end head from the filter casing, and running the entire element out on a removable track furnished with each filter installation.



For information on the many other advantages of Conkey Rotary Leaf Pressure Filters write for Bulletin No. 105.

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NEWS FROM ABROAD

Special Correspondence

McGRAW-HILL *World News*

Argentine plans chemical expansion . . . More oil refineries for Italy . . . British chemical progress display at fair . . . Bizonia to rebuild refineries.

Argentine May Build DDT And Sulfa Plants

NATIONAL ECONOMIC COUNCIL of the Argentine Republic has announced it is interested in the possibility of building factories in Argentina for the production of sulfa drugs and DDT insecticides.

Various proposals will be studied by the Council, which is the highest economic and industrial authority of the government.

Anglo Iranian Asks Italy For Refinery Concessions

ANGLO-IRANIAN has asked the Italian Government for concessions to build two crude oil refineries, one at Naples and the other at Syracuse, Sicily. The plants would be run by a corporation in which Anglo-Iranian voted 51 percent of the stock; Italians 49 percent.

Both plants would be fitted with catalytic cracking equipment. The Naples plant would be geared to handle 1,500,000 tons of crude per year; the Syracuse plant 1,000,000 tons.

Ceylon May Expand Domestic Rubber Goods Industry

SEVERAL internationally known rubber goods manufacturers are dickering with the Ceylon government with an eye to establishing factories there.

Prospects of at least one deal going through are considered good. The factories would have access to a ready supply of raw material—peak shipments during the war from Ceylon topped 110,000 long tons—and to a good market. Ceylon herself last year spent more than $2,000,000 for imported motor and bicycle tires and quality rubber goods and has only a handful of small-scale factories, among them two tire retreading plants.

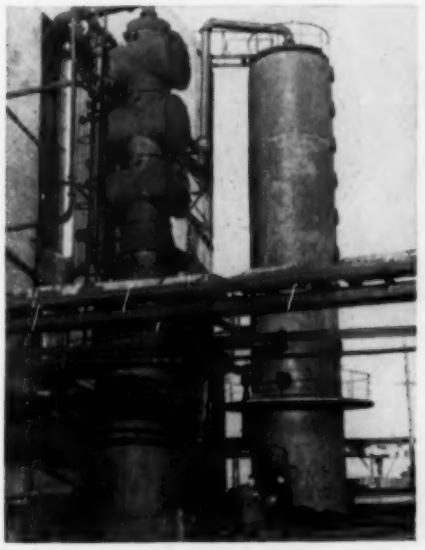
In addition Ceylon is hot for industrializing her economy to a large degree, and is shelling out a tremendous rubber subsidy to keep her plantations going in the face of lower world rubber prices and the rise of synthetics.

New Australian Acid Plants Will Use Pyrites

ABOUT three million tons of pyrites lying idle at the surface of Mount Morgan Mines are to be used in an attempt to make Australia independent of the United States in the production of sulphuric acid.

Companies interested in the plant, which will cost £1,500,000, are Broken Hill Proprietary and Shirleys Fertilizers, of Brisbane.

The sulphuric acid will be used for making fertilizer, eventually saving Australia hundreds of thousands of pounds annually in dollar expenditure.



Russians are rebuilding this coke byproduct plant. Germans destroyed it in war.

Russians Rebuilding Coke And Coal Chemical Plant

ORDZHONIKIDZE coke and chemical plant at Dneprodzerzhinsk in the Ukraine, supplies coke for the blast and coke gas for the open hearth furnaces of the Dzerzhinsk Iron and Steel

AMMONIUM SULPHATE will be produced at this $50 million plant at Sindri, India. It will have a capacity of 350,000 long tons when completed in 1950.

WORKS WHERE OTHERS WON'T

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Works—one of the biggest in Southern Russia.

The Germans destroyed all the industrial enterprises in the Ukraine. First postwar five-year plan provides for the construction and restoration of thirty blast furnaces with a capacity of 9,000,000 tons of cast iron annually, open hearth furnaces and converters with a capacity of 8,400,000 tons and rolling mills with a capacity of 6,500,000 tons of rolled goods. The coke and chemical plants are being restored along with the iron and steel works.

In April 1946 one coke battery of the Ordhonikidze coke and chemical plant was restored. After this it became possible to put the rehabilitated blast furnace No. 7 of the Dzerzhinsky works into operation. Coke did not have to be brought from distant centers. Open hearth furnaces received supplies of high Btu. gas.

A year later (May 1947) a larger coke battery was put into operation. It was built to replace the one the Germans blew up. A third coke battery is now under construction.

Britain Shows Postwar Progress In Chemicals at Industrial Fair

MARKED progress made by Britain's chemical industry in the past twelve months was reflected by this year's British Industries Fair. Delivery delays still exist for many essential products, but in general the supply position has greatly eased. Foreign buyers in particular were assured that satisfactory delivery terms could be promised. A large number of new chemicals products were exhibited for the first time at the 1948 Industries Fair. Chemical manufacturers are going after orders from foreign buyers for new products since foreign orders get priorities on scarce construction materials.

Great interest was shown in petroleum chemicals displayed by several companies. Some of these are already in production, others hope to put new plants into commission later this year. Among petroleum chemicals, manufacturers have made special efforts for the development of new detergents and other articles which may profit from the world scarcity of fats. One such new detergent has been put on the market by a subsidiary of the Anglo-Iranian Oil Co. Britain's other big oil combine, the Shell company, is extending its range of specialized products for the laundry and related trades. Petroleum Chemicals Ltd. is

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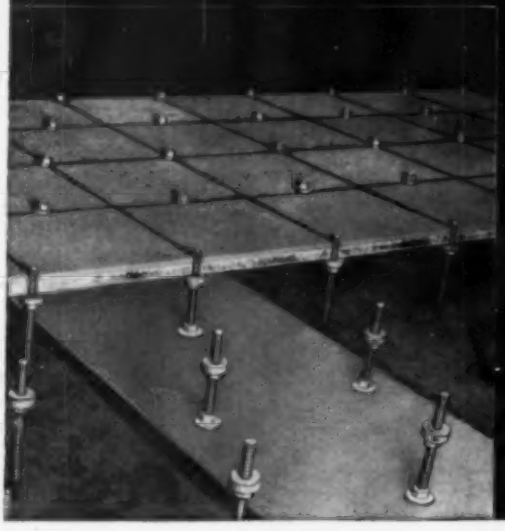

Superior to conventional filters, these porous bottoms assure improved filtration, considerably longer filter runs and ability to pass increased rate of flow. Containing no layers of graded gravel, they permit repairs and inspections to be made readily and without the heavy cost of handling the sand and gravel.

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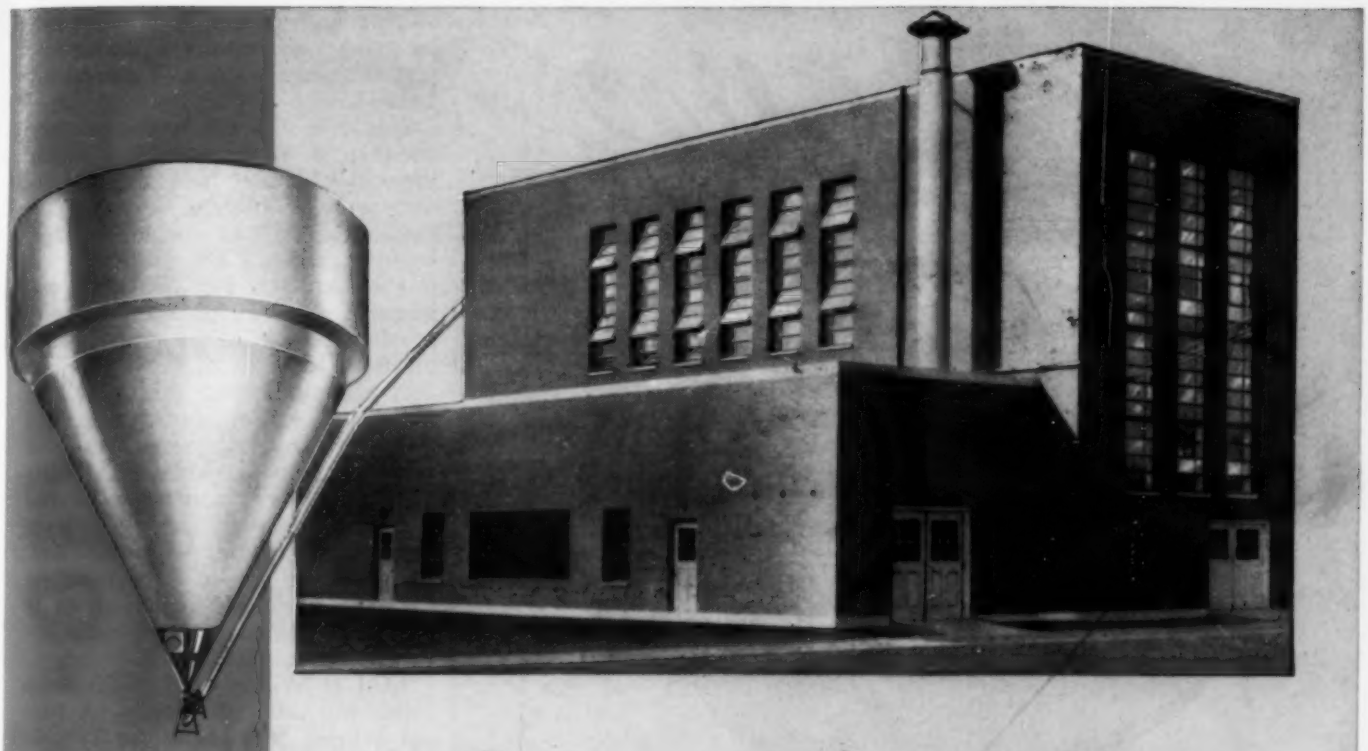

These are but a few of the many products that have been successfully spray dried:

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- Manganese sulfate
- Pentaerythritol
- Pharmaceuticals
- Pigments
- Polyvinyl Resins
- Starch (textile)
- Sulfite waste liquor and lignins
- Tannin liquors
- Zinc sulfate

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to chemicals with widely differing characteristics

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1. Instantaneous conversion of liquids to solids in a single pass
2. Conversion at low temperatures
3. Solids delivered in the form of powders that require no crushing or sifting
4. Prevention of both contamination and chemical loss by a closed system
5. Low cost production

Since the Swenson Spray Dryer Research Plant began operations early this year, tests have been made almost daily—in co-operation with numerous concerns in the process industries—to determine the practicability of spray drying chemical, food, and dairy products. The list at left represents only a few of the diversified chemicals which have been successfully dried on a full-scale operating basis.

If you have a product which can benefit from the advantages of spray drying, ask us at once for a consultation.

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Floridin

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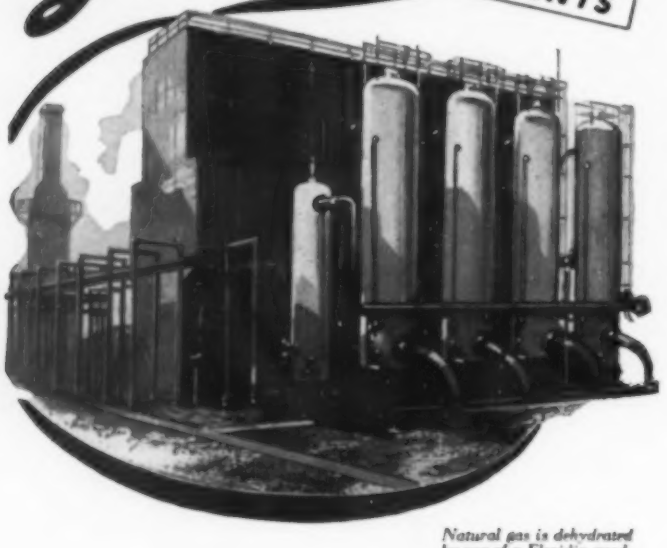

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cooperating with another firm for the processing of petroleum derivatives into secondary products of general interest.

Petroleum also will be the primary raw material of the new plant which Imperial Chemical Industries Ltd. is erecting at Wilton, on Teesside. The first unit to go into production here, before the end of 1948, will be devoted to the manufacture of Perspex, transparent sheets, and phenolic molding powders to augment the available supply from other I.C.I. factories. The next major unit after that will be a petroleum cracking plant which will be operated to yield the maximum of simple olefines suitable as starting points for making more complicated organic chemicals. Inevitably large amounts of gasoline will be obtained. These will be sent to Billingham, on the other side of the Tees river, to be used there in conjunction with hydrogenation gasoline.

I.C.I.'s Wilton and Billingham plants will cooperate closely. A tunnel is being built under the Tees to accommodate a two way pipeline system for both liquids and gases. Methane-hydrogen gases from Wilton will be used for making ammonia, methanol and petrol at Billingham. Coke and creosote from Billingham will be used at Wilton. In the early stage the Wilton plant will use methyl methacrylate made at Billingham, and later this exchange of products will continue on a growing scale. Ethylene will be polymerized at Wilton, and the polyethylene will be used for making acetone via isopropanol. An electrolytic caustic soda and chlorine plant is also to be erected at Wilton.

New Products Shown

Many products shown at the Fair were entirely new for the British chemical industry. In quite a few instances production was undertaken to overcome dependence on foreign sources. In the plastics field, interest was aroused by a new synthetic fabric made by B. X. Plastics Ltd. from its "Bexan" monofilaments. It is claimed to be resistant to most chemicals and because of its hard-wearing qualities is recommended for upholstery. British Industrial Solvents Ltd. showed methoxy-butanol, aceto - acetanilide, diallyl phthalate and methyl acetoacetate among other new alcohols and esters. British Geon Ltd. is going to produce hard vinyl compounds based on a special polymer which can be molded to form rigid articles. Itaconic and fumaric acids are to be made soon by Kemball, Bishop & Co. Ltd. New oil additives were shown by several firms, and Monsanto Chemicals Ltd. intends to make in the British Isles

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Stokes also makes Chemical and Food Processing equipment, High Vacuum Pumps and Gages, Vacuum and Atmospheric Dryers, Pharmaceutical equipment, Tablet Machines, Water Stills.

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Stokes freeze-drying chambers for penicillin at plant of Sharpe & Dohme, Inc., Glenolden, Pa.

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some of the chemical products which hitherto had to be imported from Monsanto factories in the States.

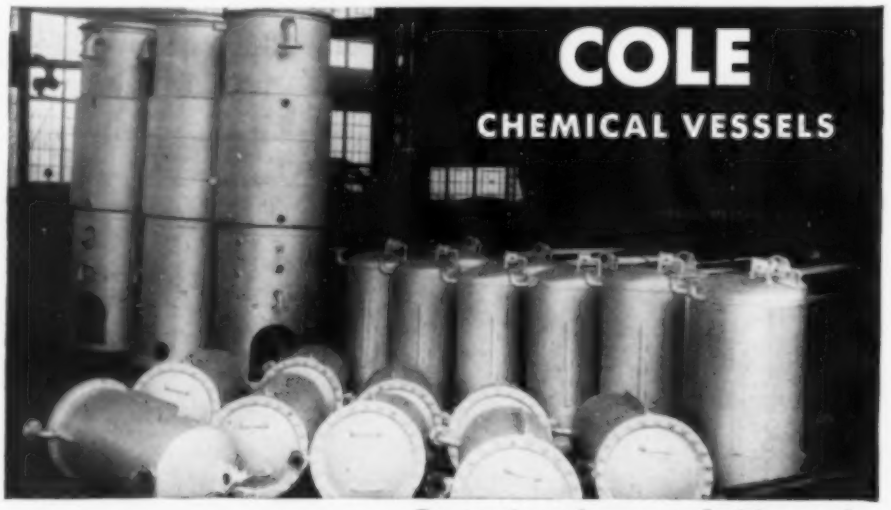
To the distilling, oil refining and rayon interests which have lately extended their chemical commitments must now be added Britain's leading aluminum producer. British Aluminium Co. Ltd. has completed plans for the manufacture of potassium and sodium chlorates in its former reduction plant at Foyers and is also considering the conversion of its alumina works at Larne. The company has started the production of a 99.99 percent pure aluminum for use as a lead substitute and for special reflectors. In the plastics field it is reported that Bakelite Ltd. intends to invest over £2,000,000 in production facilities.

Paint Industry

Substantial new finance will also be required by the paint industry and producers of raw materials for paint manufacture. Several smaller firms have bought new factories, while a development of major importance in this field is the plans for an extension of plant for titanium pigments. Special interest is shown by paint manufacturers in an enlargement of their sales in the Dominion markets. In South Africa, the subsidiaries of two leading British firms have concluded a cooperation agreement extending to production and distribution. The companies are Lewis Berger and Sons (South Africa) Ltd., owner of a large paint factory at Durban, and African Explosives and Chemical Industries Ltd., an I.C.I. subsidiary, which intends to open a paint factory at Somerset West, Cape Province. A significant move in the chemical markets was the announcement by Imperial Chemical Industries Ltd. of a number of mostly minor price reductions.

Price Cuts

The price cuts are in accordance with declared Government policy and may be expected to be followed by smaller firms in their respective fields. While these and other price concessions may seem unimportant after the large number of price increases which have taken place during the past year, they are certainly indicative of a change in the general market atmosphere. Recent financial reports showed that most chemical firms are using additional profits, from full utilization of their plant capacity, to write down the value of their fixed assets instead of raising their distributions to shareholders. I.C.I., for instance, has doubled the "special provisions for obsolesence and



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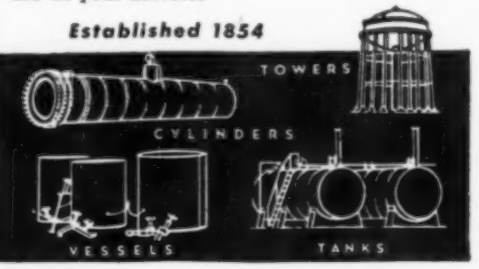

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depreciation" and made another substantial transfer to "revenue reserve". The central and special obsolesence provisions and the transfer to revenue reserve for 1947 were nearly double total dividend distribution. Such large transfers to reserves are aimed to meet high replacement costs and possible intensification of world competition. At present, however, the demand from foreign buyers remains as keen as ever. Export difficulties now being met, are due primarily to import restrictions imposed for foreign exchange reasons by overseas governments.

Russian Dye Industry Now Above Prewar Levels

SOVIET dye production this year is scheduled to surpass prewar levels, according to a recent statement made by M. Pervukhin, minister of the Soviet chemical industry, who indicated that the aniline dye industry had made great progress in recovery after having been 88 percent demolished during the war.

Published in the form of an open letter replying to charges that the chemical industry was failing to supply adequate dyes to the textile industry, Minister Pervukhin's statement disclosed that in 1947 the dye output attained was 10.5 percent above plan, and supplies to the textile mills, particularly at Ivanovo from which the complaints came, exceeded planned output. Several hundred tons of additional dyes have now been supplied to the Ivanovo mills, he stated.

Recovery has been most rapid in the sulphide dyes, Minister Pervukhin indicated, current production now being above prewar levels. Still lagging is production of vat or indigo dyes, recovery of which is associated with complete restoration of the Rubezhansk chemical plant that was demolished during the war. Resumed production of indigo dyes is scheduled for this year, he stated.

German Refineries Will Be Rebuilt in Bizonia

GERMANY'S war-blasted oil refining industry is going to be put back together again. U. S. and British military governments have approved a program to rebuild enough capacity to meet requirements in their combined zones. That calls for an industry able to process 2 million metric tons of crude oil annually. At the same time, it will be turning out about 175,000 tons of lubricants, asphalt, and waxes for export each year.

The crude oil will be imported. Germany was never self-supporting in

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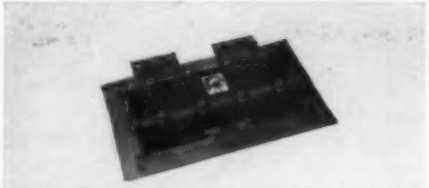

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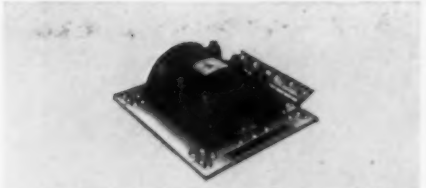

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Pulley

For automatic metal separation where materials are not conveyed on belts. Available in 16 sizes. Write for bulletin 600.

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VALVES
Nos. 8015-8020-8025

THEY STOP THE FLOW OF LIQUIDS OR GASES INSTANTLY AND AUTOMATICALLY IN TIME OF DANGER

Here are some characteristics of these widely used ASCO Solenoid Valves:

#8015 . . . Designed to be positioned manually and to remain mechanically locked in position. Automatically tripped when the solenoid is energized. Latched open valves are opened manually and tripped closed electrically. The companion type — latched closed valves — are closed manually and tripped open electrically.

#8025 . . . Plain general purpose Safety Shut-off Valves can be opened and held open manually whether or not the solenoid is energized, but will remain latched open only while the solenoid is energized. Upon current failure, the valve will close and remain closed until reopened manually.

#8020 . . . Factory Mutual approved for Air or Non-Corrosive Gas. Cannot be opened or held open unless solenoid is energized. Will close when solenoid is de-energized independent of operating handle whether valve is partially or fully opened.

If you have any installation — pipe line, machinery or instrument — where it is vital that the flow of gas or liquid be stopped instantly and automatically in time of danger, consider the ASCO Safety Shut-off Valve. It will prove a reliable "safety-first" for that installation. Write us in detail about your problem.

ASCO Solenoid VALVES

When in need of Automatic Transfer Switches, Remote Control Switches, Contactors, Relays, and Specialized Electromagnetic Controls, come to us.

Automatic Switch Co.
381 LAKESIDE AVENUE • ORANGE, NEW JERSEY

crude oil, and Bizonia's output now is around 650,000 tons a year. Still, the U. S. and U. K. figure they'll be saving about $25 million a year. That's what it's been costing to import finished products, chiefly through the U. S. Army. And that money has been coming out of appropriated funds—almost all from the American taxpayer.

Bizonia's refining industry will be operated by the recently-created German Economic Administration of the combined U. S.-British zones. Military government, however, will exercise at least some direct supervision and policy control.

Slated to run over the next two years, the over-all reconstruction plan embraces three distinct refinery operations: refining, topping and cracking, and topping and hydrogenation.

The first phase of refinery activation was started in August, 1947, primarily for the production of needed asphalt. Originally, 60,000 tons of finished asphalt were to be turned out each year. That figure has now been almost doubled, to 110,000 tons.

Germany's refineries, which were concentrated in what is now the British zone, were priority targets during the war. So there's a big repair job ahead. In addition to refinery equipment, considerable quantities of steel, cement, brick, chemicals, and other basic materials will be needed. Some refinery equipment can be salvaged from existing plants. The balance of what's needed will be manufactured in Western Germany, as with the necessary basic materials.

Caustic Soda Import Rules Eased by India

A POLICY of facilitating import licenses for caustic soda has been decided on by the Indian government as a result of extreme shortages prevailing in the country.

Annual consumption of caustic soda in India now is estimated at about 60,000 long tons compared with domestic capacity of some 12,000 long tons and actual production of between 5,000 and 8,000 long tons. Factories under construction are expected to increase actual production to about 9,000 long tons by the end of next year.

The Indian soap industry is the worst hit by the shortage. Compared to prewar production of 150,000 long tons annually 1947's output is reported as less than 100,000 long tons. Result is that the per-capita consumption of soap is less than 1 lb. compared with America's 24 lbs.

Under the new import policy the landed cost of the caustic soda must be less than $16 per cwt.

Good connections at Shell Oil

HERE is a picture of interest to everyone concerned with oil or chemical piping. The scene—a bank of heat exchangers at a Shell Oil Company cycling plant.

This labyrinth of critical piping was put together with Tube-Turn seamless welding fittings—the fittings that form a continuous, leakproof metal structure with the pipe. They are strong as the pipe itself. They fill the bill for truly permanent piping systems, free of maintenance problems.

Tube-Turn welding fittings are manufactured in a wide range of types, sizes, metals and alloys. Your nearby Tube Turns distributor carries a large stock. For fast service in good connections, specify "Tube-Turn."

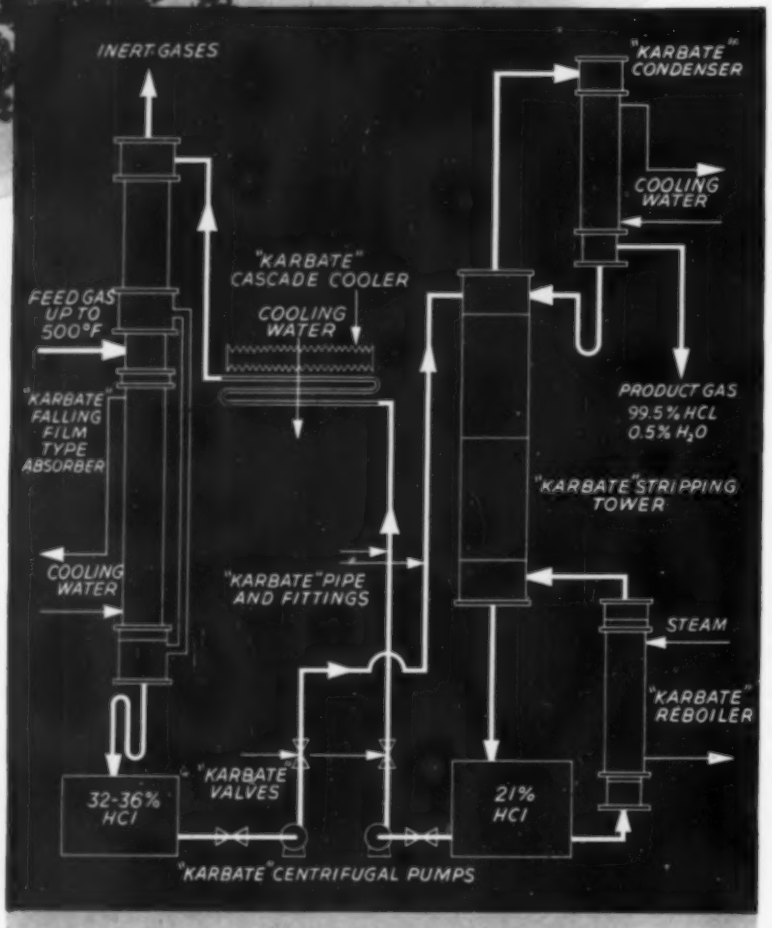
TUBE TURNS, INC.
238 E. Broadway, Louisville 1, Ky.
District Offices at New York, Philadelphia, Pittsburgh, Detroit, Chicago, Houston, Tulsa, San Francisco, Los Angeles

TUBE-TURN
tt
WELDING FITTINGS AND FLANGES

Write for copy of research paper presented before A.S.M.E., "Fatigue Tests of Welding Elbows and Comparable Double-Mitre Bends."

MAKE ANHYDROUS HCl?

Whip corrosion with "KARBATE" Impervious Graphite Equipment!



A typical flow sheet of one system for producing anhydrous HCl from feed gases up to 500 deg. F. containing inert gases.

IF YOU manufacture anhydrous HCl for use in the production of plastics, alkyl chlorides, synthetic rubber, or other materials, you can eliminate corrosion permanently by using "Karbate" Impervious Graphite corrosion-resistant equipment. The *entire* system can be assembled of *standard* "Karbate" units, including acid absorbers, cascade coolers, towers, heat exchangers, pipe, valves, condensers, pumps, tanks, and fittings. This equipment has the following advantages:

1. **Chemically inert to all concentrations of HCl**
2. **Very high heat-transfer rate**
3. **Light weight with adequate strength**
4. **Immune to thermal shock**
5. **Resistant to mechanical shock**
6. **Easy to machine and install**

For more details on the use of "Karbate" Impervious Graphite in producing anhydrous HCl, write to National Carbon Company, Inc., Dept. CE.

These products sold in Canada by Canadian National Carbon Company Ltd., Toronto 4, Canada

The term "Karbate" is a registered trade-mark of

NATIONAL CARBON COMPANY, INC.

Unit of Union Carbide and Carbon Corporation

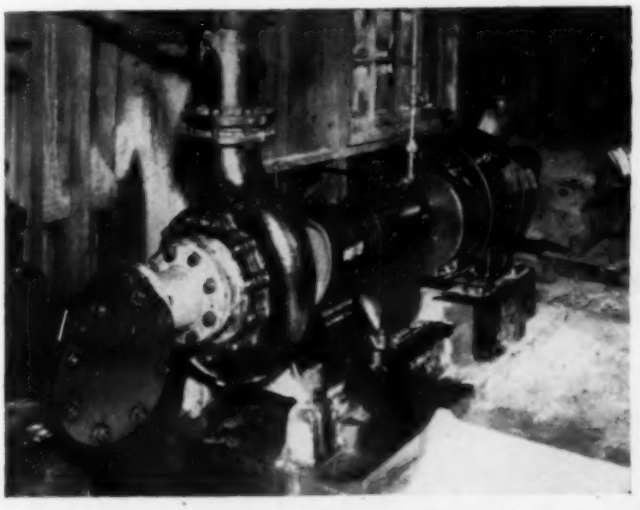
UCC

30 EAST 42nd STREET, NEW YORK 17, N. Y.

Division Sales Offices: Atlanta, Chicago, Dallas, Kansas City, New York, Pittsburgh, San Francisco

Sulphuric Acid versus Construction Materials

Part II of a symposium in which typical materials of construction are evaluated for services involving sulphuric acid.



Durimet pump has handled mixture of sulphuric, hydrochloric nitric and hydrofluoric acids at 180 deg. F. for several years.

PRECIOUS METALS

E. F. ROSENBLATT
Baker & Co.
Newark, N. J.

Silver: Dilute sulphuric acid, for instance 10 percent, does not attack silver even on boiling if air is excluded. An aerated solution of 10 percent sulphuric acid corrodes silver slightly at room temperature, strongly on boiling (1.4 mils per yr). Concentrated sulphuric acid dissolves silver at room temperature, very readily on boiling.

Palladium: Palladium is resistant to dilute and concentrated sulphuric acid at room temperature regardless of whether air has access or not. Boiling 10 percent sulphuric acid attacks at the rate of 1 mil per yr. At 150 deg. C, concentrated sulphuric acid dissolves palladium fairly rapidly, especially if aerated.

Gold: Gold is extremely resistant to dilute and concentrated sulphuric acid, whether aerated or not. Even up to boiling temperatures the corrosion loss is negligible. Though gold is superior to any other unalloyed precious metal, some of the gold platinum alloys are equally corrosion resistant and show superior mechanical properties which make them preferable for construction of equipment.

Platinum and Platinum Alloys: Platinum is completely resistant to dilute sulphuric acid under any conditions. It is attacked only very slightly by concentrated sulphuric acid even at high temperatures; for example at 250 deg. C it shows a loss of only 0.07 mils per yr.; at 300 deg. C, 0.7 mils per yr. Even with this small attack, it is inferior to gold in resistance to this acid. The commercial platinum alloys with rhodium, iridium and rutheninum show about the same corrosion properties as platinum alone, but are preferable from the mechanical standpoint. Gold platinum alloys, with a gold content of 70 percent or more, are just as resistant as gold, and are definitely superior mechanically. They are used in all cases where optimum corrosion resistance against sulphuric acid at high temperature is required; when other oxidizing agents are present, for instance, in sulphuric acid containing some nitric acid, platinum and platinum alloys containing no gold are definitely superior to gold-platinum alloys.

Precious metals, especially platinum and its alloys, have found many applications in the sulphuric acid industry. A substantial proportion of sulphuric acid is made in the contact process using platinum metal catalysts. Platinum contact catalysts are often in use for 10 years or longer and the loss over this time is more likely caused by dusting than by chemical attack. Large concentrators have been in use for many decades to concentrate sulphuric acid produced by the lead chamber process. Platinum anodes are the preferred material for inert anodes in many electrolytic baths containing sulphuric acid solution. They possess certain advantages even for nickel plating in special applications. Hydrogen peroxide is produced in cells using exclusively platinum anodes, as platinum is the only metal which will withstand the extremely corrosive conditions; even platinum anodes show some small but continuous loss which in the case of platinum-clad anodes makes the use of a substantial thickness of the platinum cladding desirable.

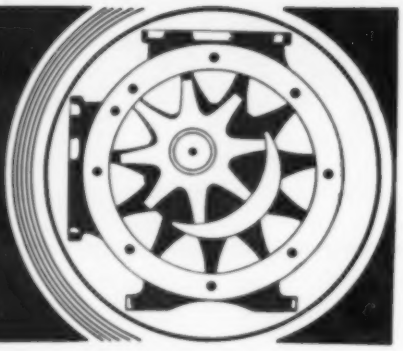
DURIMET

WALTER A. LUCE
The Duriron Co.
Dayton, Ohio

SULPHURIC ACID and solutions containing sulphuric acid are successfully handled under many conditions of concentration and temperature by Durimet 20. This is in contrast to the relatively poor sulphuric acid resistance exhibited by the conventional stainless steels. Durimet 20 is a highly alloyed austenitic stainless steel with a nominal chemical composition in the cast form of 29 percent Ni, 20 Cr, 2.0 Mo, 3.5 Cu, 1.0 Si, 0.07C max.,

VIKING

The DESIGN That Made ROTARY PUMPS FAMOUS!



It is with pride and a sense of great responsibility, that Viking has pioneered a pattern for the rotary pump field.

The pace, set by Viking for more than a third of a century, has stood this test of time.

When you are in need of pumps, it will pay you to do as others have done, consider the original "gear within a gear" Viking first. You will find a decided difference.

Look to Viking for the answer to your pumping problem. Send for free bulletin 47SC today. It will be forwarded at once.

See Our Catalog in SWEETS

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GYRATOR SIFTER

For sifting SPICES
DRUGS, HERBS, CHEMICALS
and hundreds of other ground materials.

A Schutz-O'Neill Gyrator Sifter delivers a near-perfect separation and a large volume of uniform product free from tailings, fibre, shreds or foreign particles. The continuous whirling motion of the material on the sieve's surface produces this clean separation. Built with one to three sieve frames, the Gyrator Sifter will deliver up to four grades of product. Sieve meshes are kept free from clogging, are quickly removable, and can be thoroughly cleaned in a few minutes for grinding a different product. Very light running—requires only 1 to 2 H. P. motor.

Let us Suggest a MILL PLAN—Write us your requirements, send sample of products to be sifted or pulverized and output desired, and our engineers will recommend the correct equipment at no obligation.

ESTABLISHED 1893

SCHUTZ-O'NEILL CO. DIVISION OF PARTEN MACHINERY CO

PULVERIZERS · BREAKER MILLS · ROLLER MILLS · BURR MILLS · HAMMER MILLS

301 SIXTH AVENUE SOUTH • MINNEAPOLIS 15, MINNESOTA

and balance Fe. It is this high alloy content which imparts the high resistance to this acid, especially at elevated temperatures and higher concentrations.

Durimet 20 shows negligible corrosion in all sulphuric acid concentrations at 70 deg. F. Although an increase in temperature brings an increase in corrosion rate, highly satisfactory resistance is obtained at all concentrations up to temperatures slightly below 176 deg. F. However, the resistance at 176 deg. F. depends greatly upon the acid concentration. Satisfactory resistance is obtained at this temperature up to 65 percent concentration. Sulphuric acid in the 65-93 percent range at 176 deg. F. is particularly vicious in its attack on all stainless alloys; and although care is sometimes necessary in recommending Durimet 20 in this range, numerous successful applications are on record. Durimet 20 also shows an acceptable rate of corrosion for boiling sulphuric acid up to 10 percent.

Durimet 20 is available in the form of castings and equipment made from castings such as pumps, valves, fans, ejectors, jets, and mixing nozzles. Rough castings are available to other equipment manufacturers. A limited number of wrought forms of Durimet 20 are now available.

Although high-silicon iron is recommendable for all concentrations and temperatures of sulphric acid, it is sometimes limited in its scope when a high strength machinable alloy is required or when contaminants such as sulphurous or hydrofluoric acid are present. It is for these services that Durimet 20 excels.

Typical service applications will be cited which exemplify the sulphuric acid resistance of Durimet 20. Since these applications are numerous, only a few will be mentioned.

(1) Durimet equipment is giving satisfactory service in sulphuric acid pickling solutions of 6-10 percent acid at 180 deg. F. in batch picklers and 25-30 percent at 220-230 deg. F. in continuous picklers, providing higher temperatures are not involved. It finds particular application in such items as dancer rolls and guide rolls where good mechanical properties and good corrosion resistance are required. Other equipment used in this type service are pumps, tank outlets, jets, valves, racks, and skid bars. The accompanying photograph shows a Durimet pump used to handle spent pickling acid. (2) Durimet 20 gives satisfactory service when handling a 34 percent sulphuric acid and bauxite mixture in the manufacture of alum at a temperature somewhat over 200 deg. F. Over eighteen months successful service has

IF YOU BUY OR SPECIFY CORROSION-RESISTING EQUIPMENT OR CASTINGS...

Engineers and other executives who have anything to do with the purchase or specifications of pumps, valves pipe, heat exchangers, steam jets, and other corrosive-handling equipment will find this guide an invaluable aid.

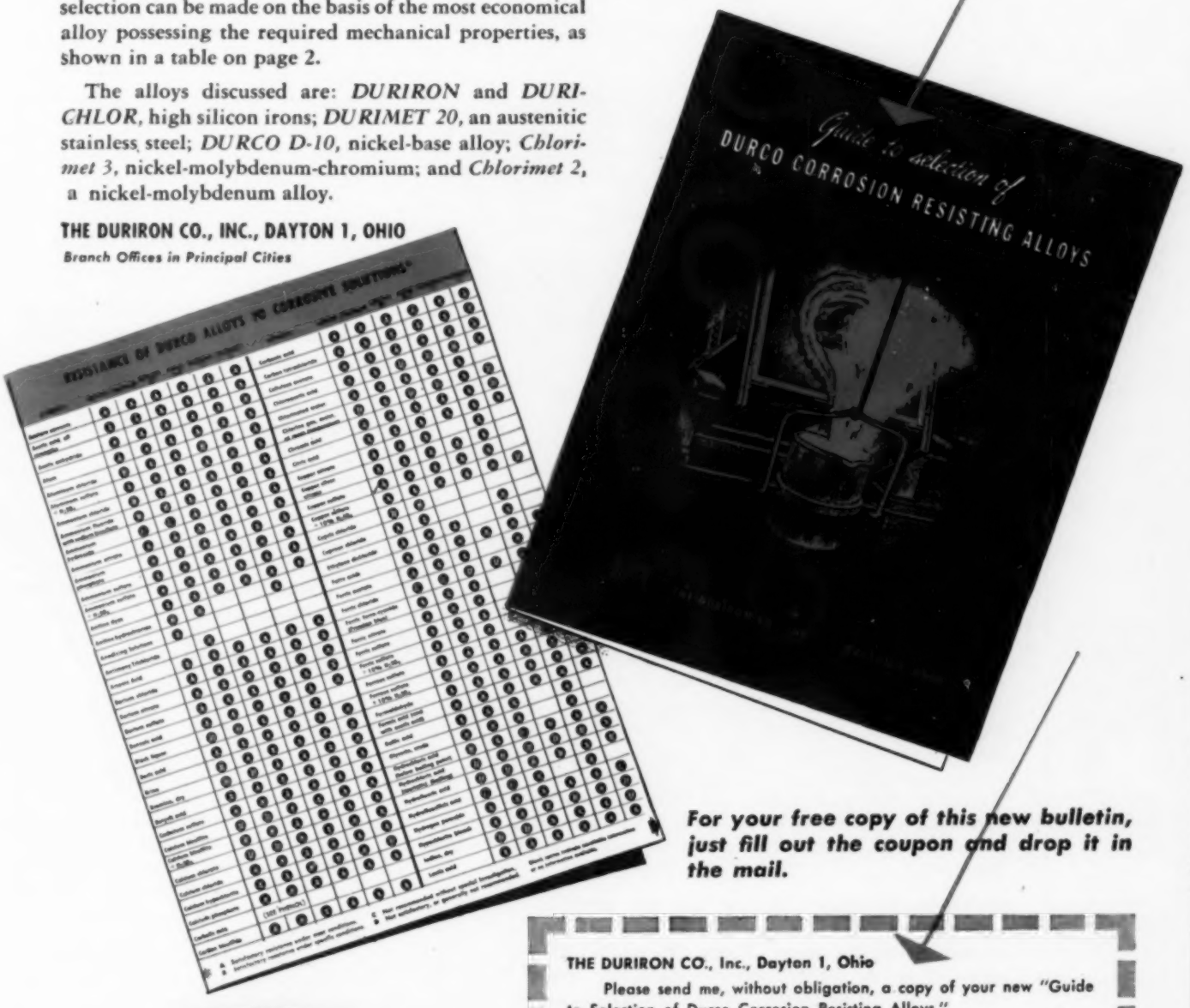
Listing 155 corrosives in alphabetical order, it shows which of five well-known DURCO alloys offers most satisfactory resistance to each corrosive. Where two or more alloys are satisfactory for a particular service, selection can be made on the basis of the most economical alloy possessing the required mechanical properties, as shown in a table on page 2.

The alloys discussed are: *DURIRON* and *DURICHLOR*, high silicon irons; *DURIMET 20*, an austenitic stainless steel; *DURCO D-10*, nickel-base alloy; *Chlorimet 3*, nickel-molybdenum-chromium; and *Chlorimet 2*, a nickel-molybdenum alloy.

THE DURIRON CO., INC., DAYTON 1, OHIO

Branch Offices in Principal Cities

you should have a copy of this NEW bulletin



For your free copy of this new bulletin, just fill out the coupon and drop it in the mail.

THE DURIRON CO., Inc., Dayton 1, Ohio

Please send me, without obligation, a copy of your new "Guide to Selection of Durco Corrosion Resisting Alloys."

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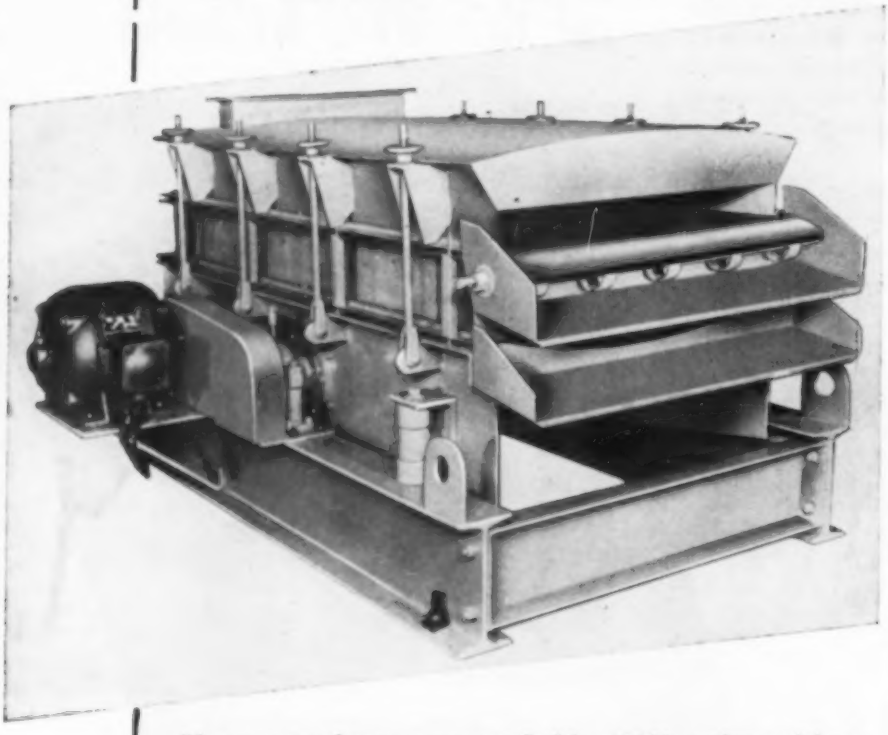
46-GM

100% SANITARY

simplicity gyrating screens speed sizing and dewatering of chemical products



If you want faster, more profitable, 100% sanitary sizing and dewatering of materials in your processing, it will pay you to investigate Simplicity Gyrating Screens. They handle a wide variety of materials and greatly increase production through the efficient Simplicity gyration. For example, in a starch plant a 2-tray Simplicity screen with 150 mesh cloth screens 180 gallons of starch fluid per minute. In a soap plant, a 4' x 8' Simplicity Single Deck Screen equipped with $\frac{1}{16}$" slotted opening cloth can screen 31,256 lbs. of powdered soap per hour, with no blinding, minimum balling, and only 4% tailings. Many plants are eliminating their stream pollution problems by passing waste through Simplicity Screens to remove solids before dumping.

Simplicity Gyrating Screens for the chemical products industry are made with 1, 2, 3, and 4 trays that are easily accessible for cleaning. There are no hidden corners or obstructions to collect dirt. Discharge spouts may be open or totally enclosed. Mild steel, 188 stainless, or 316 stainless steel construction. Send us particulars of your sizing and dewatering operations and our engineers will recommend specific Simplicity equipment that will do more and better work for you in less time and at lower cost.

Simplicity
TRADE MARK REGISTERED
Engineering Company Durand, Mich.

FOR CANADA:
CANADIAN BRIDGE
ENGINEERING CO. LTD
WALKERVILLE, ONTARIO

been obtained in this particular service even though fine sand particles are present in the alum slurry. (3) Pumps of Durimet 20 are used by a chemical company to handle a solution containing 10-20 percent sulphuric acid plus 1-5 percent hydrofluoric acid at 120-140 deg. F. (4) Durimet 20 is giving excellent service handling a tanning solution containing 4 percent sulphuric acid plus 19 percent sodium chloride at room temperature. (5) Numerous applications for Durimet equipment in oleum services are being continuously reported. Generally, the temperature is considerably above normal room temperature. (6) Large quantities of Durimet 20 are being used to handle various sulphuric acid solutions, with and without contaminants, in textile mills, rayon and cellophane plants, byproduct coke works, electrolytic manganese plants, and numerous other diversified chemical plants.

CARBON, GRAPHITE

W. W. PALMQUIST
National Carbon Co.
Cleveland, Ohio

RESISTANCE of carbon, graphite and impervious carbon and graphite to the corrosive action of all but the most highly oxidizing concentrations of sulphuric acid solutions has been established in numerous and varied applications over a period of years. All forms of carbon are inert to highly ionized concentrations of sulphuric acid. Corrosion resistance is not dependent upon any surface phenomena or coating formed by reaction. Metallic contamination is eliminated, and there is no discoloration of solution after an initial period of operation.

Applications of carbon, graphite, and Karbate impervious carbon and graphite in the handling of sulphuric acid are as varied as the numerous uses of the acid would indicate. In general, the use of one particular form is settled by the properties of the materials, such as resistance to the specified concentration and temperature, weight, cost, strength, machinability, size, thermal conductivity and imperviousness. All of the materials are practically immune to thermal shock.

Structural carbon can be used with all concentrations of sulphuric acid from 0 to 96 percent by weight. Use in the vapor phase is limited only by the presence of sulphur trioxide at the upper limits of concentration and temperature. Graphite does not exhibit the degree of resistance to the high sulphuric acid concentrations shown by carbon. The use of carbon is, therefore, preferred for concentrations above 60 percent by weight, and

ATLANTIC PETROLEUM CHEMICALS

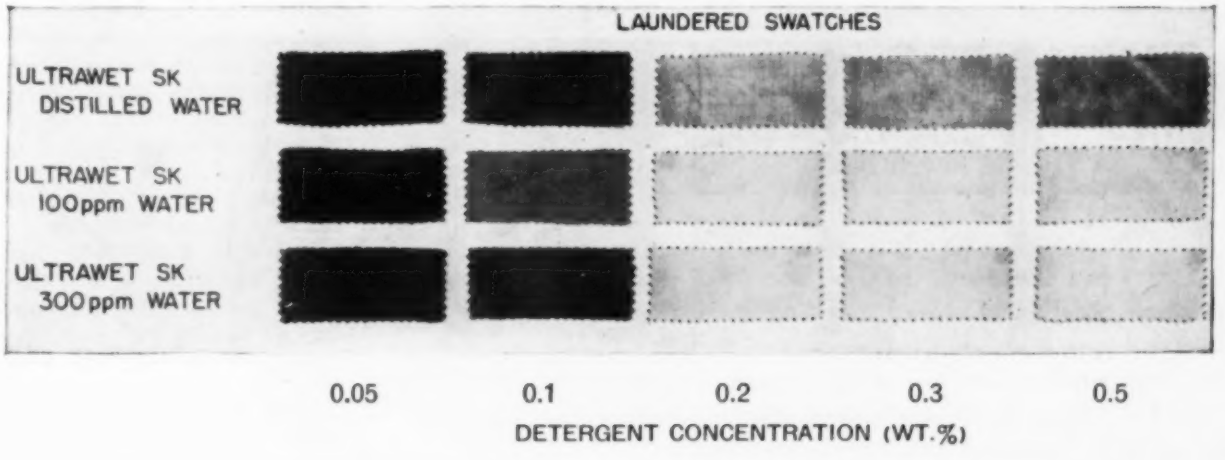
ULTRAWET K's

Is your detergent efficient in all kinds of water?

• If not, it will pay to investigate Atlantic's new Ultrawet SK. The efficiency of this improved detergent actually increases as water becomes harder. As shown below, Ultrawet SK is even more effective in water with a hardness of 300 ppm than in distilled water. *It eliminates the trouble and expense of water softening.*

• Ultrawet SK is one of the new K series of alkyl aryl surface-active agents. This family is the latest development of an organization that has been producing superior detergents and wetting agents for over 10 years. Ultrawet K's are backed by Atlantic's great research facilities. They are now available in quantity in the following types:

Physical form	*Wt. % Active Sulfonate—min.*
Ultrawet K (flakes)	**85**
Ultrawet 30K (liquid)	**25.5**
Ultrawet SK (beads)	**35**



Picture shows wool detergency of Ultrawet SK. Wool swatches impregnated with a synthetic soil are washed in a standard launderometer. The wash solutions consist of stated concentrations of detergent and water of type indicated. Tests are conducted for 20 minutes at 105° F., and followed by 2 rinses.

For samples, further information and quotations, contact

THE ATLANTIC REFINING COMPANY

CHEMICAL PRODUCTS DIVISION

260 South Broad Street, Philadelphia 1, Pa.
Chamber of Commerce Building, Pittsburgh 19, Pa.
Hospital Trust Building, Providence 1, R. I.
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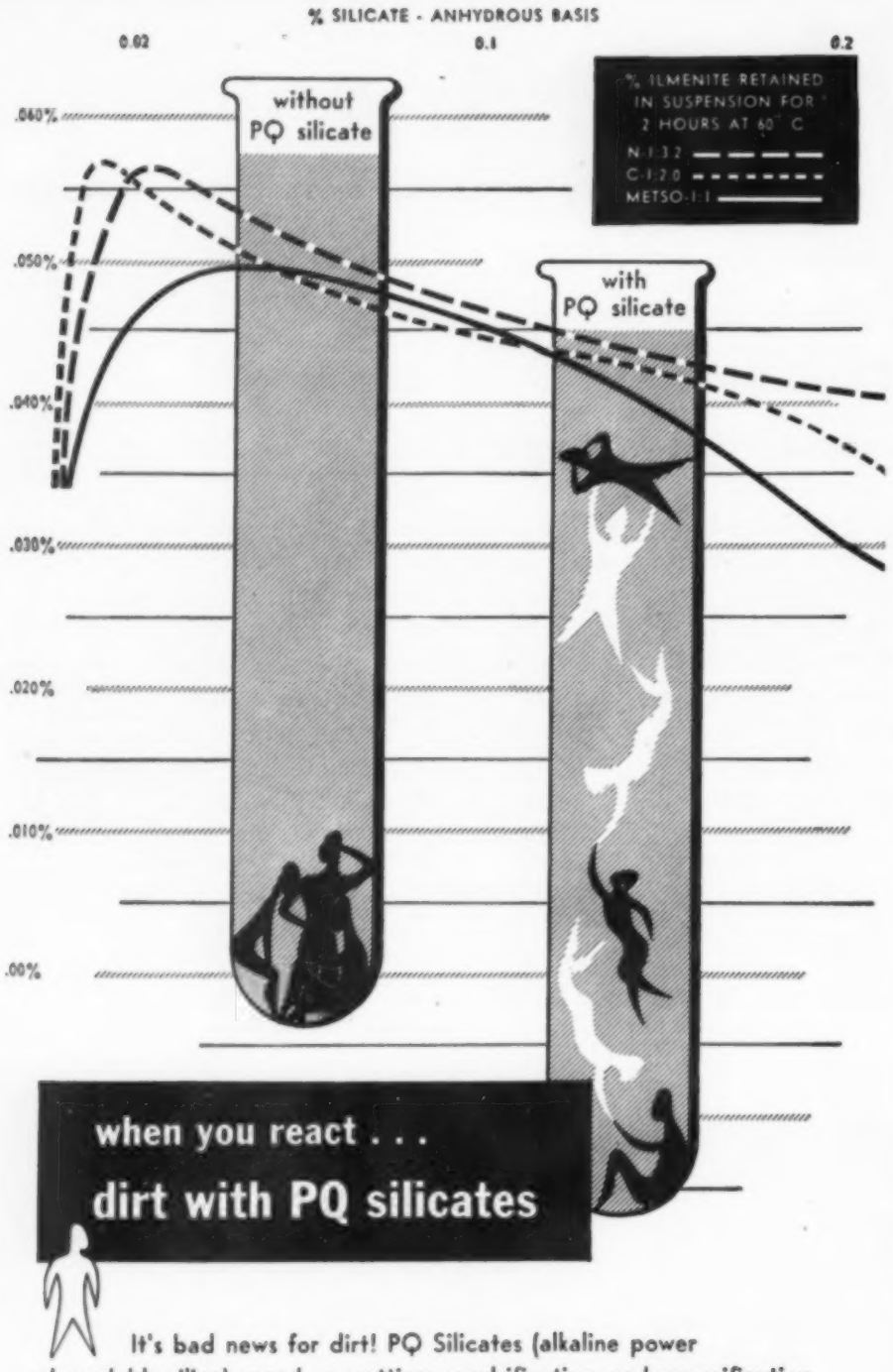


when you react . . .

dirt with PQ silicates

It's bad news for dirt! PQ Silicates (alkaline power plus soluble silica) speed up wetting, emulsification, and saponification of dirt and keep it suspended. The action of the soluble silica component, available only in silicates, stops the natural affinity of removed dirt for a clean surface. Thus, silicate detergents* or silicated soaps insure top cleaning performance.

Details of research studies with pigments such as ferric oxide, ground mica, graphite, coal, carbon black, vermilion, ultramarine burnt and raw umber are available.

PHILADELPHIA QUARTZ CO., Dept. A, 119 S. Third St., Phila. 6, Penna.

The suspending property of PQ Silicates is widely used also in the refining of clays, phosphate, graphite, and fluorspar. For the answer to a flocculating or deflocculating problem, see PQ.

*Metso Detergents (sodium metasilicate—sodium sesquisilicate)

structural carbon used in such concentrations should have a negligible content of the graphitic form. In lower concentrations, the easily machined graphite is often preferable. Carbon and graphite are inert in reducing conditions at all commercial temperatures; in atmospheres where oxidants are present, temperatures to the threshold air oxidation temperatures of 600 deg. F. and 800 deg. F are suitable for carbon and graphite respectively.

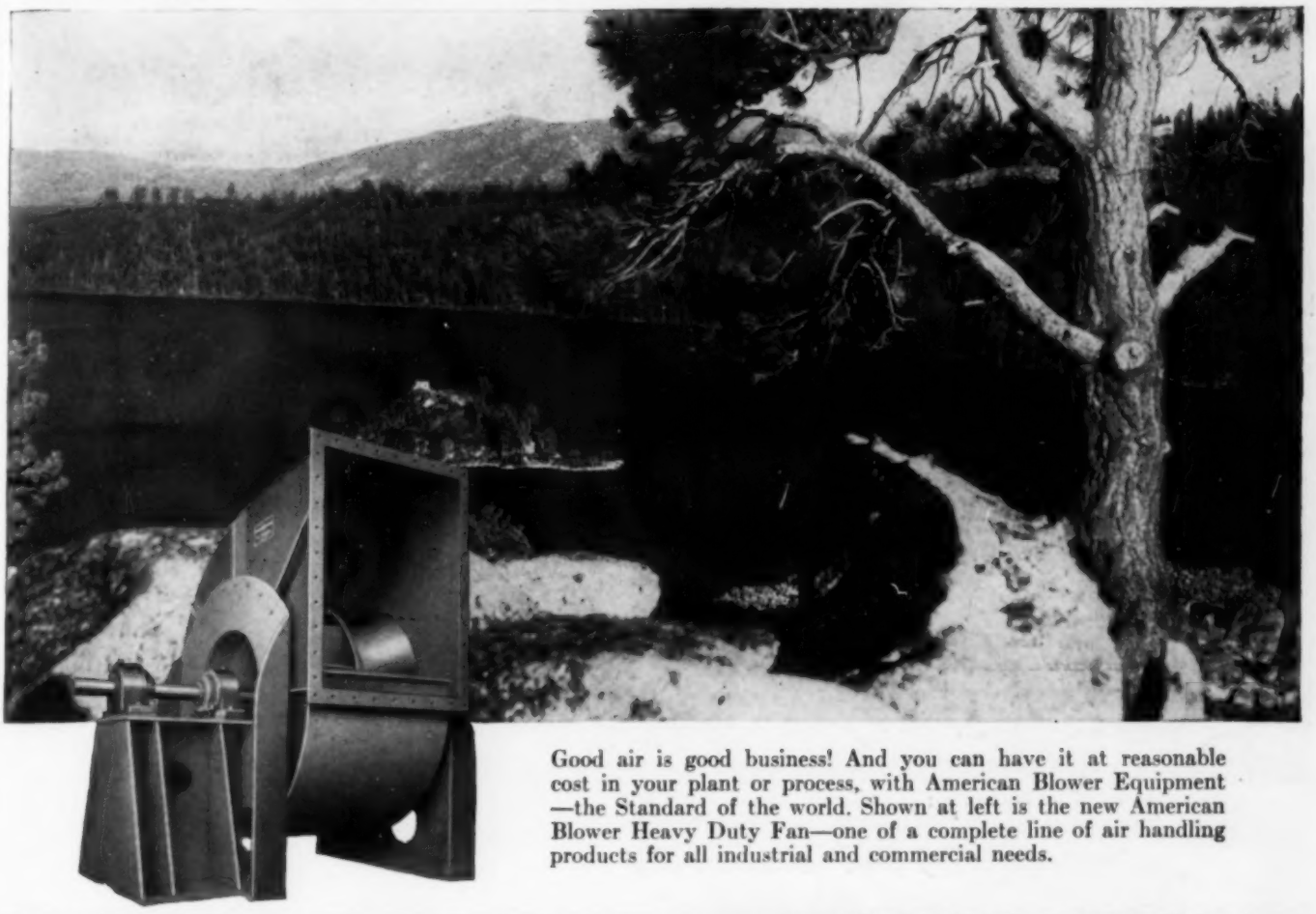
Karbate impervious carbon and graphite are suitable for concentrations of sulphuric acid solutions from 0 to 96 percent. Resistance of the carbon base and graphite base materials are identical for practical purposes. Processing temperatures to 340 deg. F are permissible with both impervious carbon and impervious graphite; in vapor phase applications considerably higher gas stream temperatures are possible when means for keeping the body temperature of the material below 340 deg. F are provided.

In addition to their corrosion resistance to sulphuric acid solutions, carbon, graphite and Karbate have also proved satisfactory for service with mixtures of sulphuric acid and other corrosive agents, notably hydrochloric acid and chlorides, phosphoric acid and phosphates, sulphates, fluorides and organic solvents. In general, carbon, graphite and Karbate may be used in mixtures when they are suitable with each of the components. Such a rule does not always apply in cases where an additive or contaminant increases the oxidizing properties of the solution, usually by chemical reaction. For example, the presence of a relatively small amount of nitric acid in the stronger concentrations of sulphuric acid may under certain conditions cause oxidation of carbon materials by forming the highly oxidizing nitrosylsulphuric acid.

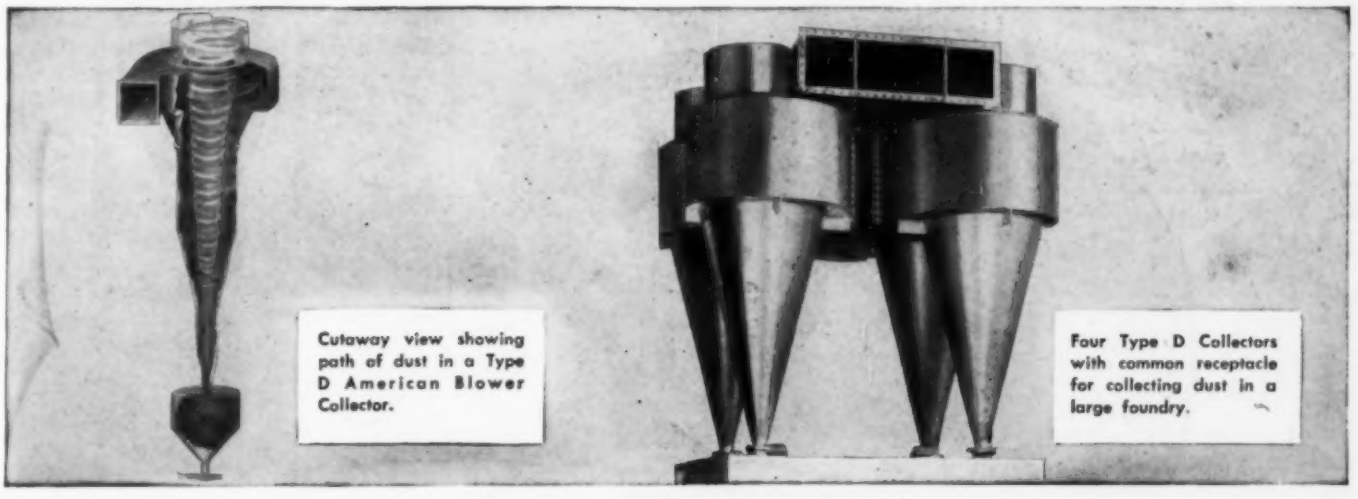
Cements for use with carbon, graphite and Karbate are of two types; carbonaceous and synthetic resin. Carbonaceous cements, which in service are essentially carbon, exhibit the resistance of that material. Certain synthetic resin cements may be used with confidence for sulphuric acid solution concentrations from 0 to 75 percent. In the concentration range from 75 to 96 percent, exposed surfaces of the cement gradually lose strength. This effect may be minimized by use of threaded type joints, which do not depend on the cemented bond for mechanical strength; butt-type joints should be avoided.

Typical examples of structural carbon construction are the numerous all-carbon electrostatic precipitators in United States ordnance plants

Keep *clean* air in *your* plant...



Good air is good business! And you can have it at reasonable cost in your plant or process, with American Blower Equipment —the Standard of the world. Shown at left is the new American Blower Heavy Duty Fan—one of a complete line of air handling products for all industrial and commercial needs.



Cutaway view showing path of dust in a Type D American Blower Collector.

Four Type D Collectors with common receptacle for collecting dust in a large foundry.

...keep it *free* of dust!

Dust can be doomed in operations involving buffing, calcining, cleaning, conveying, drying, grinding, mixing, smelting, spraying, etc., by using American Blower Dust Collectors. Phone one of our branch offices today for data on dust collectors and all other air handling, heating, cooling and drying equipment.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
In Canada: CANADIAN SIROCCO CO., LTD., WINDSOR, ONTARIO

AMERICAN BLOWER

Division of American Radiator & Standard Sanitary Corporation

SMOOTH INTERIOR Assures FREE FLOW

P. P. & E. *Stainless* STEEL WELDING FITTINGS

For all Corrosion-Resisting Applications

Smooth, uninterrupted flow is assured in any piping system using P.P.&E. stainless steel welding fittings because:
(1) The interior walls of each fitting are free from scores, scratches, die marks, waves, or ridges.
(2) All elbows are "long radius"—1½ times nominal pipe size.
(3) All fittings perfectly match corresponding tubing and pipe sizes in circularity and in wall thickness.
(4) The ends are accurately machine tool cut—fittings of wall thickness over .083" are beveled to 37½° with approximately 1/16" straight face; those with wall thickness of .083" or lighter are cut straight, not beveled.

P.P.&E. fittings are available in Stainless Types 304, 316, and 347—to match pipe and tubing of various wall thicknesses in sizes from ¾" through 12".

The most complete line of Stainless Steel Welding Fittings

Send for Catalog S-309

STAINLESS ALLOY DIVISION
PITTSBURGH PIPING and EQUIPMENT COMPANY
10 43rd Street · Pittsburgh, Penna.
World's Largest Manufacturer of Stainless Steel Welding Fittings

The ~~GUESS~~ IS OUT WHEN YOU MEASURE YOUR VALUABLE STORED LIQUIDS With LIQUIDOMETER Tank Gauges

100% AUTOMATIC
FOR GAUGING LIQUIDS OF ALL KINDS
APPROVED BY UNDERWRITERS LABORATORIES

WRITE for COMPLETE DETAILS

"LIQUIDS WORTH STORING ARE WORTH MEASURING"

THE LIQUIDOMETER CORP.
36-29 SKILLMAN AVE., LONG ISLAND CITY, N.Y.

All-carbon construction gives electrostatic precipitator corrosion resistance.

during the recent war. Initial installations had been made with carbon tubes and tube support beams or grillage. Because of corrosion difficulties with other materials in other parts of the unit, later installations were complete carbon structures as shown in the accompanying photo.

A carbon stack fabricated of large blocks is being used in a similar application for the scrubbing of gases from concentration equipment containing considerable quantities of H_2SO_4 mist. The gas stream contains sulphur oxides in addition to the acid mist and is at a temperature of 375 deg. F. Carbon linings and carbon nozzle and ejector liners are used in vacuum-type sulphuric acid concentration equipment, where the combined properties of resistance to thermal shock, corrosion resistance to a wide range of H_2SO_4 concentrations and temperatures and low thermal conductivity are advantageous. It has been reported that case lead or lead-lined steel pipe which is in turn lined with carbon can be used at vapor temperatures up to 400 deg. F and acid strengths to 96 percent. Also reported is the preferred use of carbon as a lining for lead or rubber-lined steam ejectors and barometric condensers where erosion is added to the corrosion problem.

Graphite linings and bubble-cap trays are being used successfully in the scrubbing of organic vapors containing SO_2 and sulphuric acid mist up to 40 percent concentrations with dilute sodium hydroxide solutions. Such trays are often made of impervious graphite for additional strength. Graphite fume ducts and

Wind Maker, Not a Rain Machine

Custom design and careful, experienced engineering of C. H. Wheeler Induced Draft Water Cooling Towers assures minimum water loss, this principally by natural evaporation. Offset Herringbone Drift Eliminators catch all but an imperceptible trace of moisture in the air, thus no mist falls on the landscape adjacent to the tower. Drawing above illustrates how they work. Air passing thru layers of blades changes direction and deposits moisture on the underneath side; this builds into drops and falls downward into the towers. . . . Catalog No. 145 gives other reasons why C. H. Wheeler Towers are used all over the United States and in foreign countries. Write for it today.

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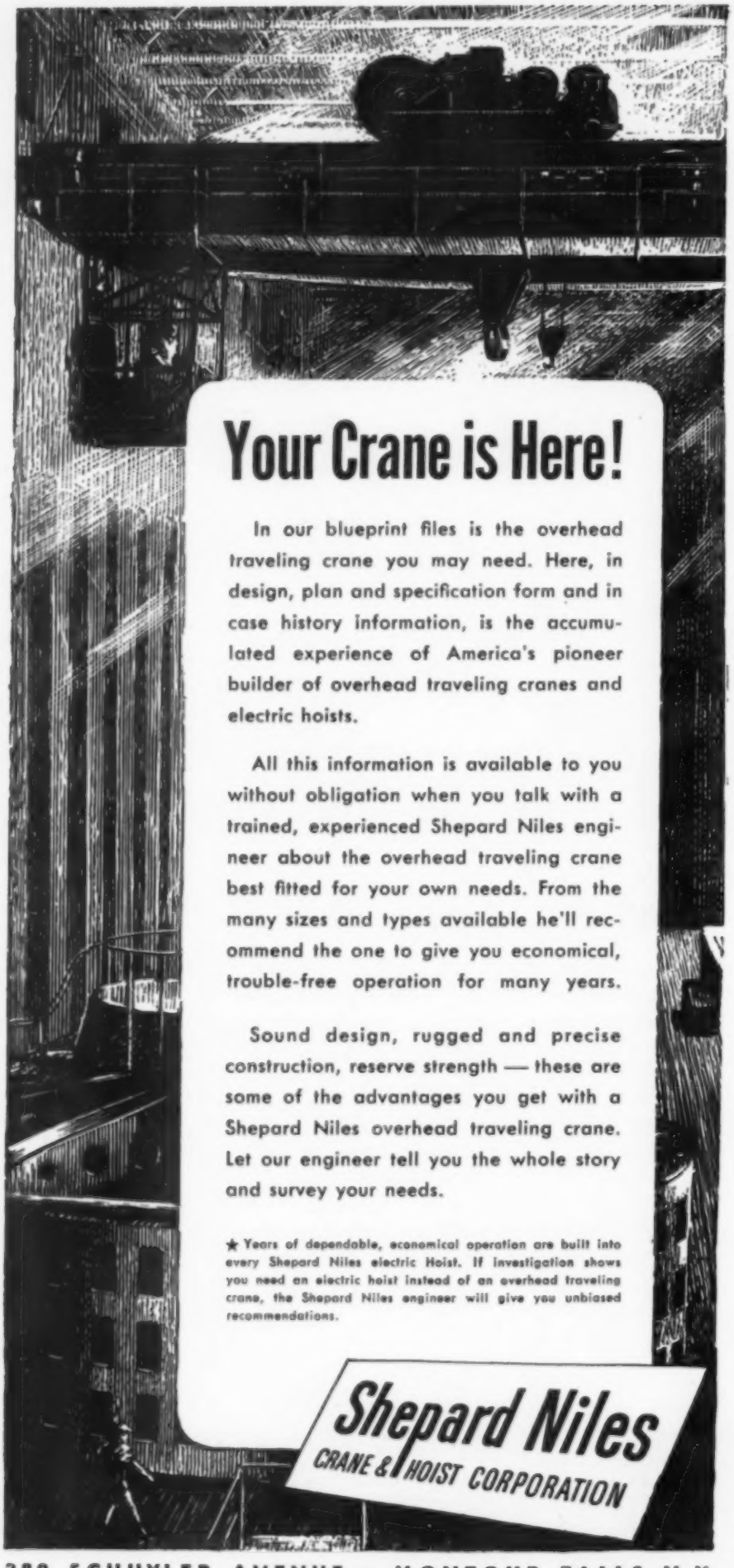
Your Crane is Here!
In our blueprint files is the overhead traveling crane you may need. Here, in design, plan and specification form and in case history information, is the accumulated experience of America's pioneer builder of overhead traveling cranes and electric hoists.
All this information is available to you without obligation when you talk with a trained, experienced Shepard Niles engineer about the overhead traveling crane best fitted for your own needs. From the many sizes and types available he'll recommend the one to give you economical, trouble-free operation for many years.
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★ Years of dependable, economical operation are built into every Shepard Niles electric Hoist. If investigation shows you need an electric hoist instead of an overhead traveling crane, the Shepard Niles engineer will give you unbiased recommendations.
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CRANE & HOIST CORPORATION
382 SCHUYLER AVENUE • MONTOUR FALLS, N. Y.

linings also handle corrosive vapor streams containing quantities of H_2SO_4.

Karbate materials find their widest use in heat exchangers handling solutions of sulphuric acid with or without other corrosive agents. Types available include bayonet, plate, cascade, steel-jacketed concentric, concentric tube, shell and tube, Baudelot, and falling-film. Such heat exchangers are used in sulphuric acid concentration systems, dilution units, and other operations. For instance, tube bundle type external heaters are in use with sulphuric acid vacuum concentrators. Good, consistent rates of heat transfer are obtained at 30 psi. steam pressures. Karbate tube bundle exchangers are being used as external boilers in a similar process for the evaporation of ethyl alcohol and ethyl ether from a water solution of sulphuric acid; 50 psig. steam is used on the shell side. Over four miles of Karbate tubes have been placed in such service. A diluting system employing a simple Karbate mixing chamber feeding hot, dilute acid from the zone of mixing directly into a Karbate cascade cooler has been in operation for over two years, diluting 66 deg. Be. sulphuric acid to a 45 deg. Be. concentration. Boiling temperatures are reached in the initial portion of the cooler.

Karbate tubes are also found in rayon spin bath evaporators. One such evaporator is designed to evaporate water from an aqueous solution containing 8.5 percent H_2SO_4 and 21 percent Na_2SO_4 at 3.5 in. Hg abs. with 15 psig. steam on the shell side. The Karbate tubes are held in antimonial lead tube sheets by special ring gaskets. Karbate tube bundles are reported as being operated successfully in the evaporation of sulphuric acid containing suspended beryllium sulphate crystals; service life of over two years has been attained at present.

Immersion type heat exchangers find widest application in plating, pickling and electrolytic polishing. Such units are being used successfully with dilute sulphuric acid solutions containing such additives as copper sulphate, phosphoric acid and hydrochloric acid.

Karbate pipe and fittings, valves, centrifugal pumps and other process accessories are used in connection with many types of sulphuric acid applications. Representative of such service is a centrifugal pump which has been in service for five years handling "bug-juice," a mixture of approximately 7 percent H_2SO_4 and 30 percent hydrochloric acid used for the knock-down scrubbing of hydrogen chloride gases from Mannheim furnaces. Previous metallic pumps had an average service life of several weeks.

When You Need MORE CORROSION RESISTANCE

in Handling Sulphuric and Many Other Acids—

Use the *NEW Carpenter* STAINLESS NO. 20

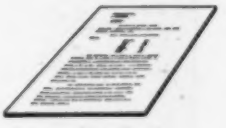
For an Extra Margin of Safety!

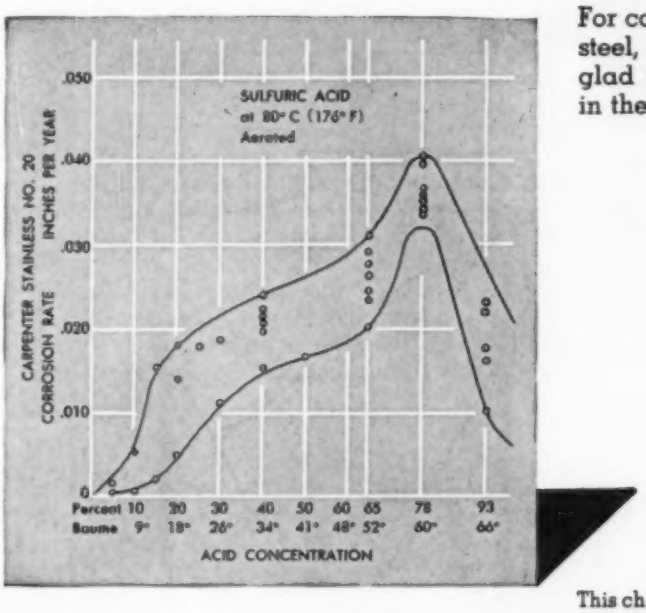
For the first time, this Stainless is available in the forms of bars, wire, strip and tubing.

If you are familiar with this alloy in its cast form, known as Durimet 20, you have a good idea of the corrosion resistance provided by Carpenter Stainless No. 20. Now that Carpenter's research has solved the problem of producing this Stainless in wrought forms, the material can take on new and important jobs.

In addition to its excellent resistance to sulphuric acid, Carpenter Stainless No. 20 is well suited for the handling of other acids and corrosive agents. For example, it is used in the handling of acetic, nitric and crude phosphoric acids, black liquor, calcium phosphate, etc.

For complete information on the properties of this new Stainless steel, drop us a note on your company letterhead. We will be glad to put a set of Carpenter Stainless No. 20 Data Sheets in the mail for you.





This chart shows the ability of Carpenter Stainless No. 20 to resist the corrosive effects of sulphuric acid at temperatures of 80°C (176°F). The danger zone, indicated by the "hump", is in the range of 65-93% sulphuric acid at 80°C (176°F). In this range the conventional 18-8 Cr-Ni-Mo austenitic steels (Types 316 and 317) show corrosion rates many times greater than illustrated here. While Carpenter Stainless No. 20 shows accelerated corrosion, it is far superior to the 18-8 grades and is satisfactory for most of this concentration range.

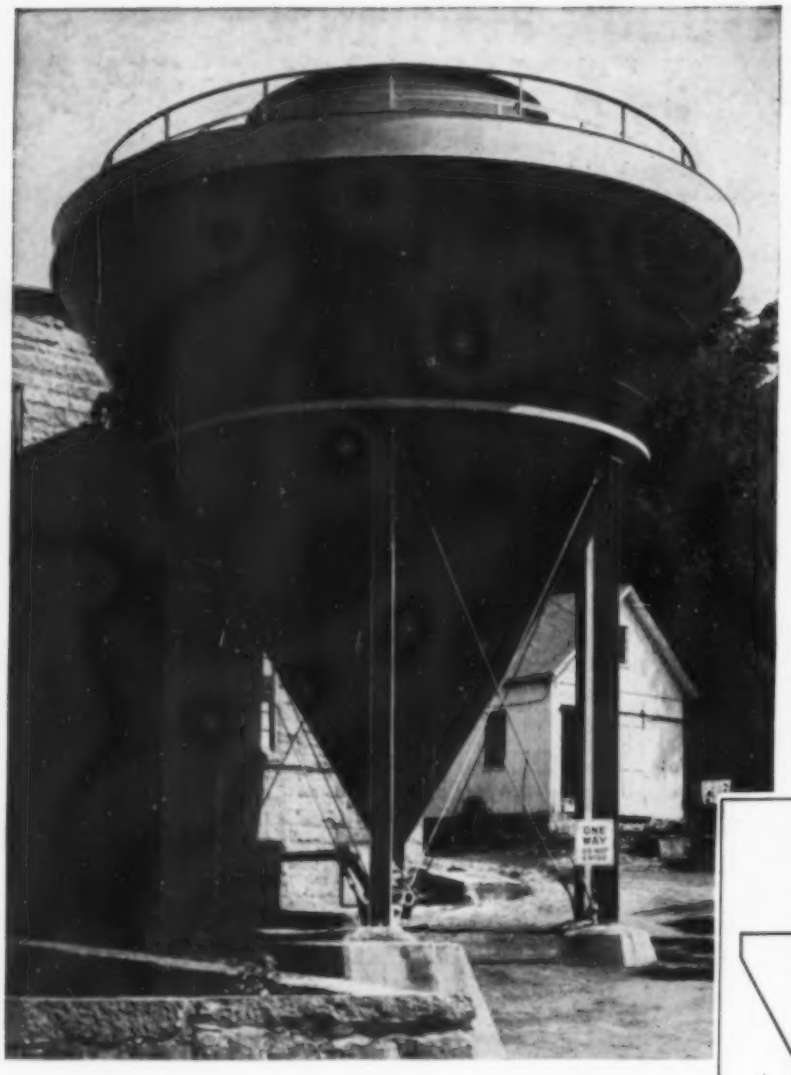
THE CARPENTER STEEL COMPANY

127 West Bern Street, Reading, Pa.

Carpenter

STAINLESS NO. 20

Licensed under patents of The Duriron Co., Inc.



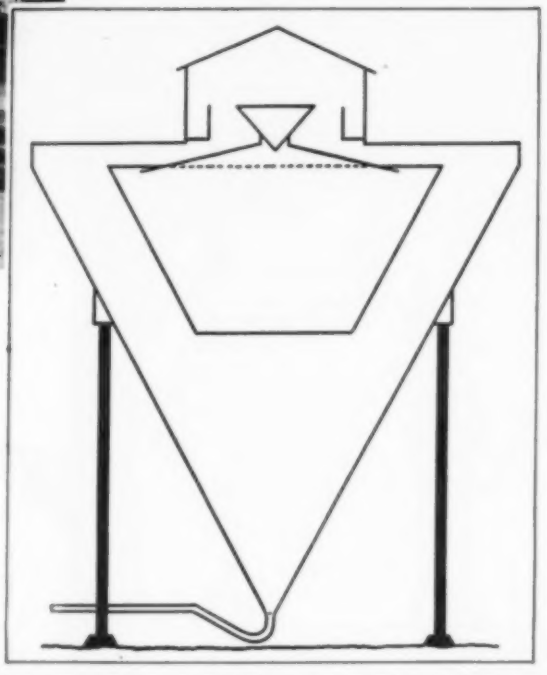
HOW TO REMOVE

97.4%

OF THE FIBROUS SOLIDS FROM WASTE WHITE WATER

The Marx Saveall shown at the left was recently erected at a paper boxboard mill to clarify the white water effluent from the paper machines prior to its re-use or discharge. A recent report shows that this Saveall is 97.4% effective . . . . . reducing suspended fibrous solids in the waste water from 4.66 lbs. per 1,000 gals. to 0.10 lbs.

The clarification process in a Marx Saveall is accomplished by settling. The diagrammatic sketch below shows the construction details of the Saveall.



Marx Savealls are typical examples of the special steel plate structures we build for chemical and process plants. Let our engineers work with you on your next steel plate work requirements.

HOW THE MARX SAVEALL WORKS

The Marx Saveall consists primarily of two large steel plate cones, one mounted inside the other as shown at the right. The inner cone has a large opening at the bottom.

There is a small cone-shaped receiving well at the top and an inverted de-aeration cone directly under the receiving well. Waste white water from the paper board machines is fed into the receiving well at the top, overflows onto the de-aeration cone and over its outer edge into the center of the unit. The suspended solids settle through the bottom of the inside cone, collect in the bottom of the outside cone and are drawn off and fed into a continuous beater for re-use. The water, minus most of the solids, rises between the two cones and overflows into a weir at the top of the outer cone. From there it is piped to storage tanks for re-use in the beater room or it is discharged into a nearby stream.

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NAMES IN THE NEWS

Man of the Month

H. A. Curtis

EARLY last month President Truman nominated Harry A. Curtis to succeed the retiring Dr. H. A. Morgan as a director of the Tennessee Valley Authority.

Dr. Curtis will be no newcomer to TVA if the appointment is confirmed by the Senate. He was made chief chemical engineer in 1933. He held this position until 1938 when he became dean of the college of engineering at University of Missouri.

Harry Alfred Curtis was born in Sedalia, Colo., Feb. 16, 1884. He attended the University of Colorado; attained his B.S. in 1908; and later taught chemistry until war service interfered. In addition to teaching experience at Colorado, Northwestern and Yale, he has held varied industrial positions: chief chemist, plant superintendent, general manager, and director of research. Other facets in the background that Dr. Curtis can bring to TVA include service as chief of Commerce's nitrogen survey, member of Coolidge's Muscle Shoals Commission, and chairman of the division of chemistry and chemical technology of the National Research Council.

In addition to being a member and vice president of AIChE, Dr. Curtis is a member of ACS and AAAS. His home at present is in Columbia, Mo.

Raymond B. Seymour has resigned as director of the Industrial Research Institute of the University of Chattanooga.

W. W. Winship

W. W. Winship, Jr.

William W. Winship has established Winship Silica Products Co. in Freeport, L. I., N. Y. **W. W. Winship, Jr.,** succeeds his father as manager of the Thermal Syndicate, Ltd.

Harold G. LeMay is now acting as research and development engineer of styrene experimental polymerization at the Dow Chemical Co., Midland. His new position follows a transfer from the saran development division, where he was a foreman.

Osgood V. Tracy, previously manufacturing coordinator of chemical products for Standard Oil Development Co., has been appointed to the newly created post of assistant manager of the chemical products department of Esso Standard Oil Co. He has also been named a director of Enjay Co.

Charles W. Deane has been appointed chief engineer of E. R. Squibb's & Sons. Dr. Deane will head all Squibb engineering activities, domestic and foreign, with responsibility for engineering, maintenance, construction, and engineering aspects in the development of new processes and products.

Christian H. Aall has been promoted to the newly created position of field research technologist for Monsanto Chemical Co.'s plant at Monsanto, Tenn. Dr. Aall will be in charge of research to develop improvements in existing operations at the Tennessee plant on matrix washing, furnace-burden preparation and furnace operations for the production of elemental phosphorus.

George O. Curme, Jr., has been elected vice president—chemical research of Union Carbide and Carbon Corp. Dr. Curme has been for many years a vice-president and director of Bakelite Corp. and Carbide and Carbon Chemicals Corp.

Backrach

G. O. Curme, Jr.

W. C. Edmister

Wayne C. Edmister, who supervised process design of the atomic pile at the Brookhaven National Laboratory on Long Island, has been appointed a professor of chemical engineering at Carnegie Institute of Technology.

Wendell G. Fogg has been appointed executive engineer of the Air Reduction Sales Co. In his new capacity Mr. Fogg will assist the director in the planning, coordination and review of the activities of the research and engineering department.

W. G. Fogg

D. P. Morgan

D. P. Morgan has joined the Mathieson Chemical Corp. as administrator of research and development. Dr. Morgan is in charge of market research as well as chemical research and development. For the past two years he has

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PUMPS ENGINEERED TO FIT YOUR NEEDS

Roper manufactures an extensive line of precision-built pumps to serve a multitude of applications in bulk stations, tank trucks, tanker terminals, refineries, and industrial plants. Illustrated are three examples of pumps in Roper series 3600, K, and F — each representative of varying pressure and capacity ranges.

FIG. 3600 MARV—A general purpose motor driven unit designed to handle thin or heavy viscous liquids at slow speeds. Has built-in relief valve, all enclosed gear guard, babbitted bearing support, bed plate and coupling; fitted for standard motor frames. Other models rated also from 40 to 200 g.p.m.

FOR PRESSURES TO 60 LBS. P.S.I.
CAPACITIES FROM 40 TO 200 G.P.M.

FIG. 1K with Packed Box — Supplied in 30, 40, and 50 g.p.m. sizes with companion flanges. Especially suited for fuel supply or transfer work. New Roper venturi suction and discharge principle minimizes energy loss caused by cavitation, turbulence, or friction. Other models available in ¾ to 50 g.p.m. sizes.

FOR PRESSURES TO 150 LBS. P.S.I.
CAPACITIES IN 30, 40, 50 G.P.M. SIZES

FIG. 1F — Features four-port design offering eight optional piping arrangements. Hydraulic self-lubricating principle prolongs pump life; can be direct connected or belt driven; ideal for pumping clean liquids of all kinds. Other models — including relief valve models — available in 1 to 300 g.p.m. sizes.

FOR PRESSURES TO 300 LBS. P.S.I.
CAPACITIES FROM 1 TO 300 G.P.M.

Send for Catalog on Complete Line

Illustrating and describing pumps built to handle pressures up to 1000 lbs. p.s.i., capacities ¾ to 300 g.p.m., at speeds up to 1800 r.p.m.

ROPER Rotary Pumps

GEO. D. ROPER CORP., 146 Blackhawk Park Ave., Rockford, Ill.

been with W. R. Grace and Co. in New York in charge of chemical market research and development.

Ernest A. Hauser has been appointed full professor in the department of chemical engineering, Massachusetts Institute of Technology.

Arthur R. Broadman has been elected assistant vice president of Heyden Chemical Corp. In his new post Mr. Broadman will have charge of engineering for the entire corporation. Mr. Broadman joined Heyden in 1939 and was engaged in production development and research.

A. R. Broadman

L. H. Flett

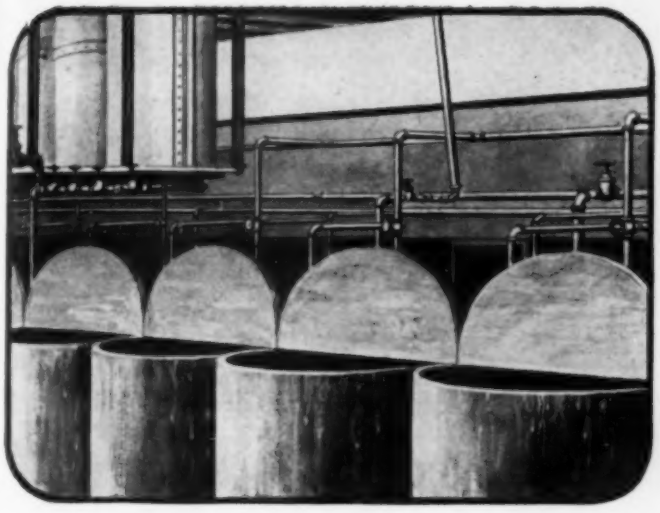
Lawrence H. Flett, director of the new products division of the National Aniline division of Allied Chemical & Dye Corp., has been elected president of the American Institute of Chemists.

Peter M. Bernays, assistant professor of chemistry at Illinois Institute of Technology, has been awarded a $4,000 grant for one-year study of the chemistry of scandium (rare metallic element). The award is a Frederick Gardner Cottrell grant by the Research Corp. of New York.

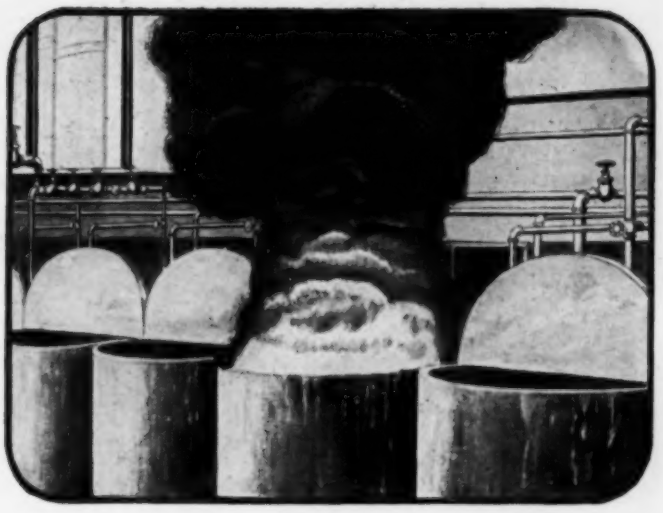
Edward R. Weidlein, director of the Mellon Institute for Industrial Research, Pittsburgh, has been awarded the Priestley Medal, highest honor in American chemistry. Dr. Weidlein, a former president of the American Chemical Society and AIChE, who has been identified with the Mellon Institute since its early years, was cited for "distinguished services to chemistry." He will receive the medal at a meeting of the society in the fall.

Otis R. McIntire has been named laboratory research director of the saran polymerization laboratory at the Dow Chemical Co., Midland. He replaces **G. W. Stanton** who transferred to the company's Great Western division to head activities of a new polymerization laboratory being formed at Dow's Pittsburg, Calif., plant.

Theodore A. Werkenthin, a materials engineer with the Bureau of Ships, Washington, has been assigned additional duties as civilians-in-charge of



If agitators or mixers—



burst into flames—

SMOTHER THE FIRE

THE *Kidde* WAY!

Fire in agitators or mixers handling flammable liquids can spread beyond control in a matter of seconds! Be ready to act when the fire *starts*—with a *Kidde** Carbon Dioxide System.

Carbon dioxide (CO_2) from Kidde Nozzles—aimed straight at the danger spot—pours into tanks, screens hatches to cut off the flames' supply of oxygen. Fire can be extinguished quickly—*without* diluting or contaminating your mixes. No corrosion of metal parts—no after-fire mess to clean up.

Ask one of our representatives for full details on *Kidde* Systems.

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● If you choose the wrong filter base, improper filtration and higher costs may result. Sperry's expert engineers, on the other hand, will study your particular problem and recommend the filter base to do your filtration job right.

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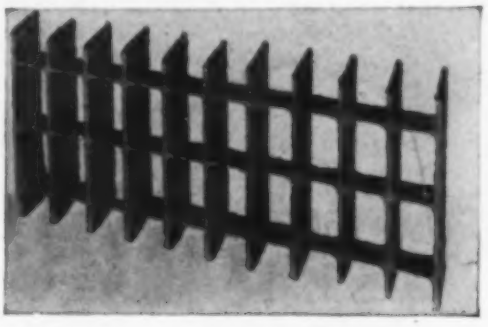

. . . under Extreme Conditions

The section illustrated was cut from a panel of Hendrick Mitco that for twelve years was in an open yard between buildings in an industrial plant. It not only was exposed to rain, snow and atmospheric corrosion, but was in a drainage area and actually under water much of the time.

The joints show the least corrosion and have no crevices or cracks, although the side surfaces of the bars have been roughened and partially eaten away.

Write for detailed information on Hendrick Mitco Grating, Open Steel Flooring, Shur-Site Treads, and Armorgrids.

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Perforated Metal Screens
Architectural Grilles
Mitco Open Steel Flooring,
"Shur-Site" Treads and
Armorgrids

the special fuels section. The section is responsible for research on petroleum, synthetic and special fuels, including work on oil shale.

Frank D. Pickel formerly technical director of the Vitamoil Laboratory and research chemist for the International Vitamin Corp. has been appointed a project leader for the Evans Research & Development Corp., New York.

Edward L. Ghormley, formerly of California Research Corp., has joined the staff of George Armistead, Jr., consulting chemical engineer of Washington, D. C. Ghormley, who has recently completed graduate work at Massachusetts Institute of Technology, will be engaged in process and design engineering.

Walter W. Carre, Jr., plant manager of the New Orleans plant of U. S. Industrial Chemicals, Inc., has been named manager of the company's new plant to be erected at Brownsville, Tex. Mr. Carre's successor as manager of the New Orleans plant is **H. F. McLaughlin,** who has served for three years as assistant manager. **John V. Lynn** has been appointed assistant manager.

J. B. Rogerson

W. M. Carney

J. B. Rogerson, formerly refinery superintendent, has been advanced to the position of manager of manufacturing by Lion Oil Co. He assumes jurisdiction over both refinery and chemical plant operations of Lion at El Dorado, Ark. **W. M. Carney** has been promoted from assistant refinery superintendent to refinery superintendent.

Bertha M. Robertson has retired after more than 30 years' of government service, practically all with the United States Tariff Commission. Mrs. Robertson has long been associated with the publication of the Tariff Commission's periodical reports on the chemical industries.

Richard B. Bernstein of Union, N. J., has been appointed assistant professor of chemistry at Illinois Institute of Technology.

R. C. Amero has accepted a position at the Johns-Manville Research Cen-

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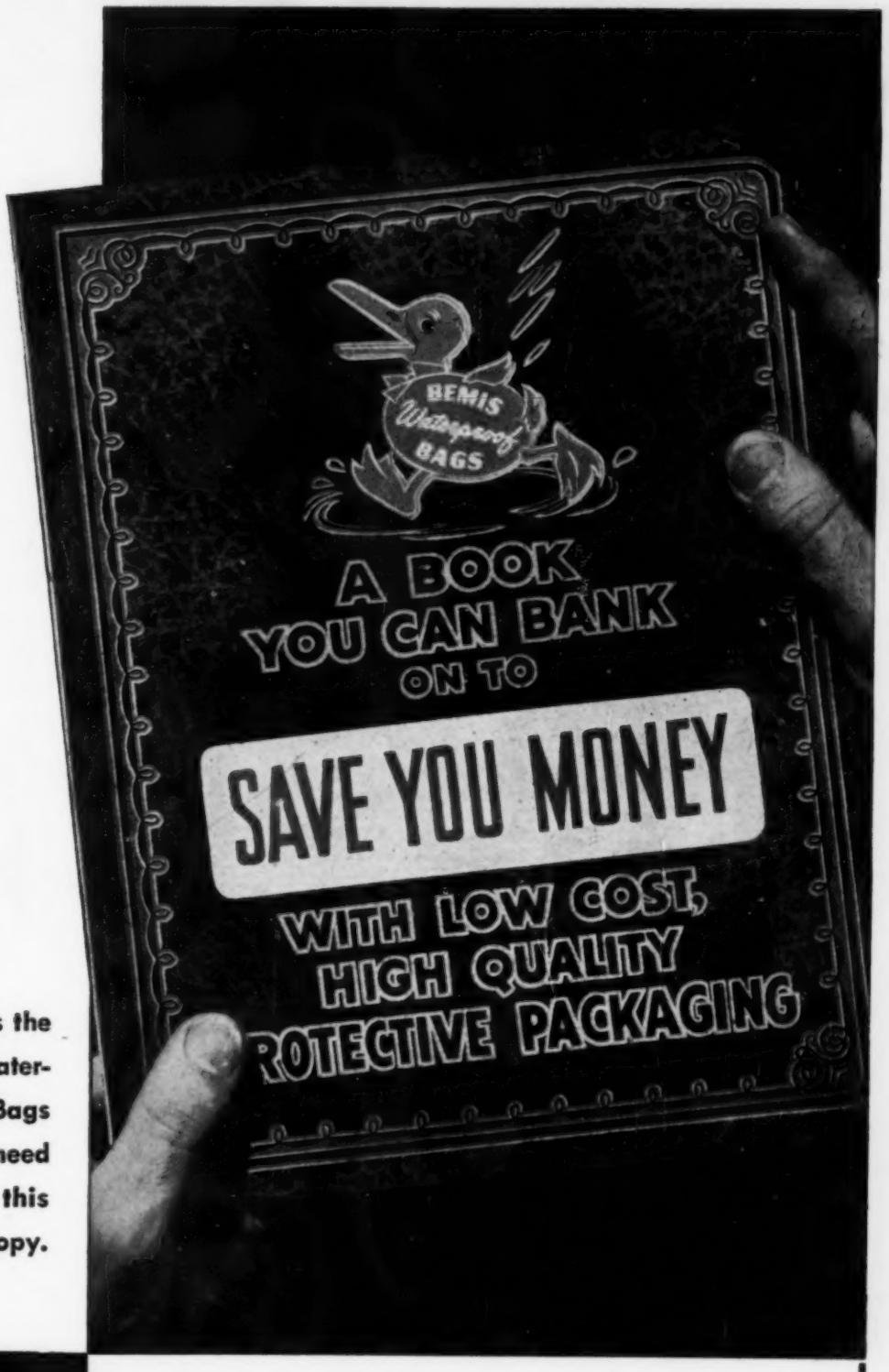

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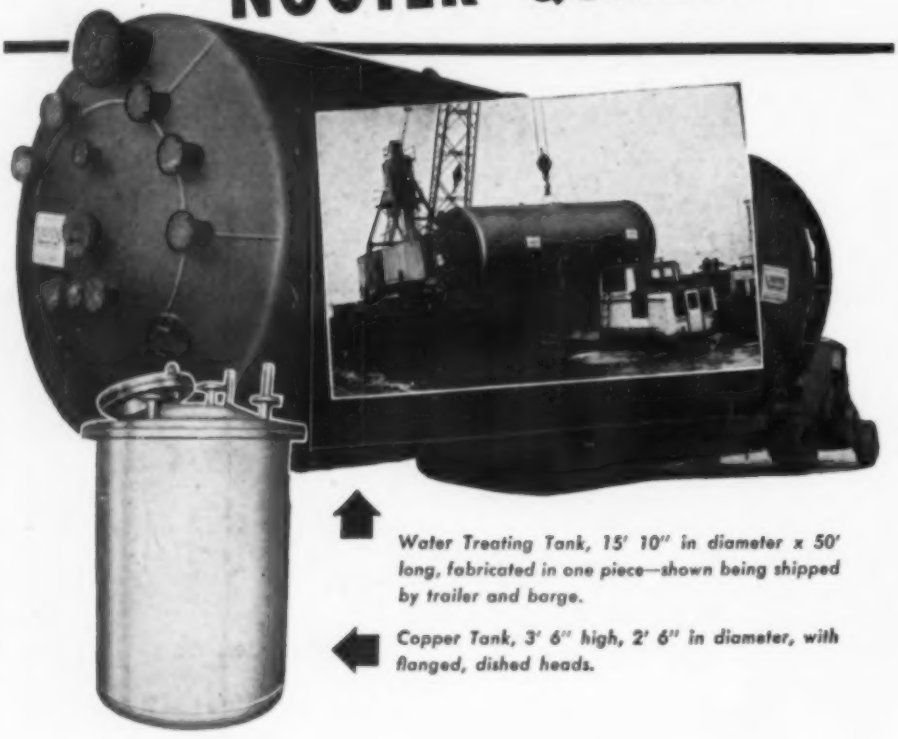

Water Treating Tank, 15' 10" in diameter x 50' long, fabricated in one piece—shown being shipped by trailer and barge.

Copper Tank, 3' 6" high, 2' 6" in diameter, with flanged, dished heads.

Whatever the size of your job—it pays you to count on Nooter for dependable highest quality fabrication. Step by step each job follows the same successful formula to attain the Nooter hallmarks of quality:

PURITY AND PRECISION—Complete adherence to detailed specifications insures structural exactness, efficient performance. Rigid inspection, including hydrostatic, pneumatic, and X-Ray assures safety and strength.

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These advantages of Nooter craftsmanship are the result of the techniques and skills of the Nooter metallurgical specialists who guide and control each fabrication job. Their thorough background of technical knowledge of metals and alloys is your guarantee of unexcelled quality.

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ter. He was formerly with the Floridin Co. in Warren, Pa.

W. E. Brinker has left the chemical division of Corn Products Refining Co. to assume new duties with the engineering division in Chicago. The position of director of engineering is now filled by **W. L. Faith. Horace Hinds, Jr.**, is now director of development engineering, Dr. Faith's previous position.

Lester L. Bauer, director of engineering at Plaskon Division, Libbey-Owens-Ford Glass Co., has been advanced to director of production to succeed **Bernard W. Slater**, resigned.

R. F. Moran has been appointed central process control director, Westvaco Chemical Corp., New York. In his new position Mr. Moran will supervise and coordinate all process control activities at all Westvaco plants and serve as liaison on technical phases of production between Westvaco's production, technical and technical sales divisions.

R. F. Moran

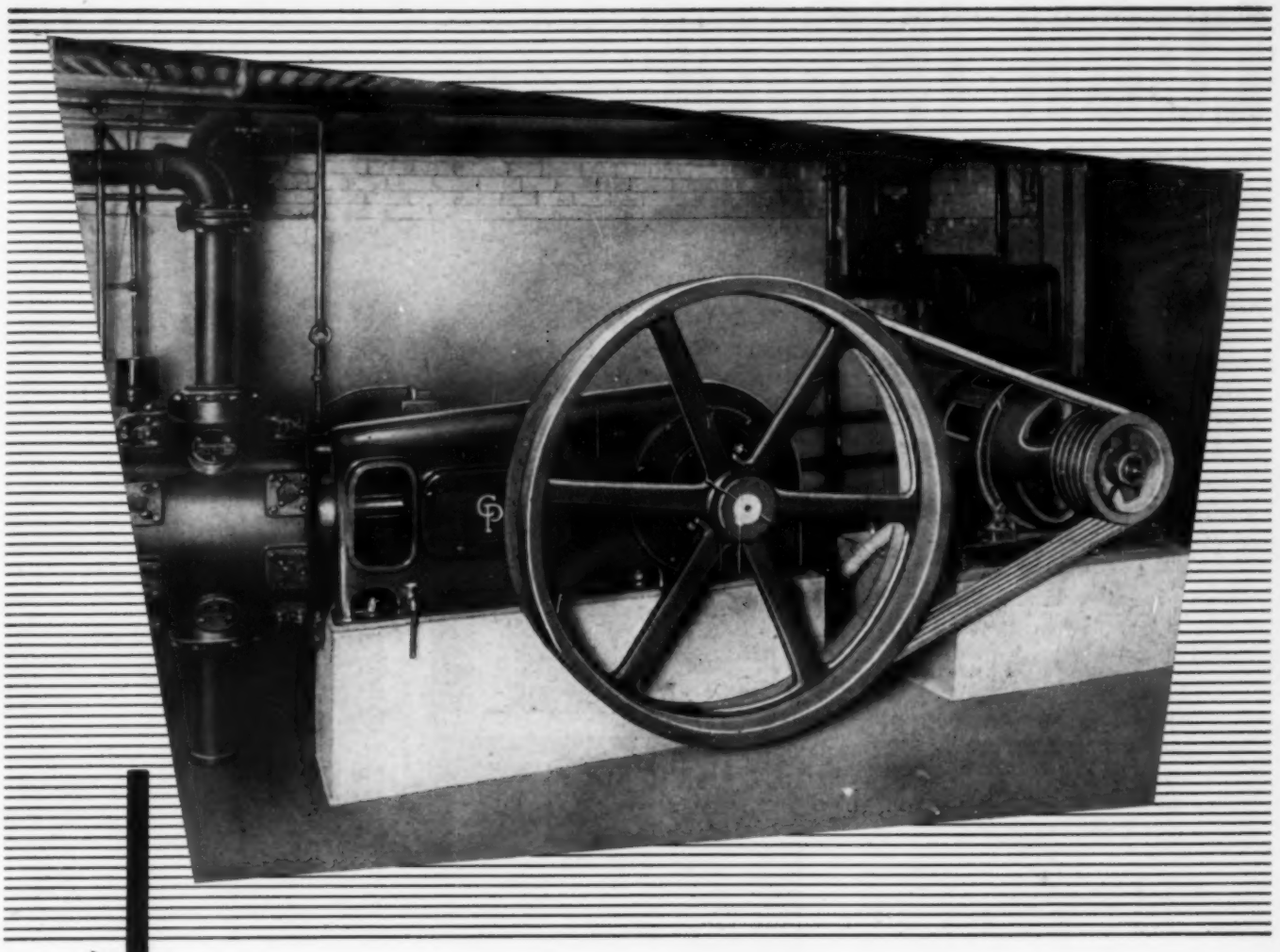
G. L. Haller

George L. Haller has been named dean of the school of chemistry and physics at the Pennsylvania State College, succeeding **Frank C. Whitmore** who died last June. Dr. Haller was made assistant dean of the school of chemistry and physics in 1946, and last June was named acting dean of the school.

Emmit W. Archer is now a research and development engineer in the magnesium laboratory of the Dow Chemical Co., Midland.

John Y. Beach, James O. Clayton and **Ronald T. Macdonald** have been designated "research associates" at the Richmond Laboratories of California Research Corp., a Standard of California subsidiary. The new designation was established to further emphasize the research company's policy of recognizing outstanding scientific ability and accomplishments among its laboratory technical personnel.

F. E. Barrows, member of the New York patent law firm of Pennie, Edmonds, Morton, and Barrows, was elected president of the Chemists'



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Simplate valves . . . liberally water-jacketed cylinder and heads . . . adjustable, tapered roller main bearings . . . double-counter-weighted crankshaft . . . are some of the CP features that have made it outstanding.

Type TB Compressor is furnished in sizes from 89 to 1937 c.f.m., with V-belt, flat belt, and direct-connected synchronous motor drive. Single and multi-stage designs for pressures up to 5,000 pounds, and steam-driven types are also available.

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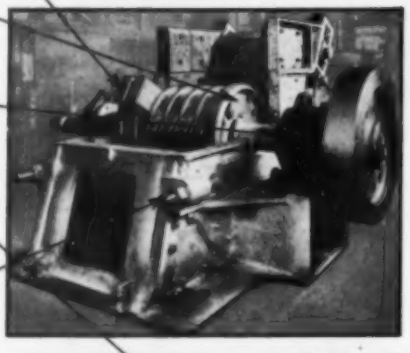
Moving Breaker Plate carries material into path of hammers.*

Easily replaceable cast manganese steel wear liners.

Hammers of various weights & designs to suit the needs of material to be crushed.

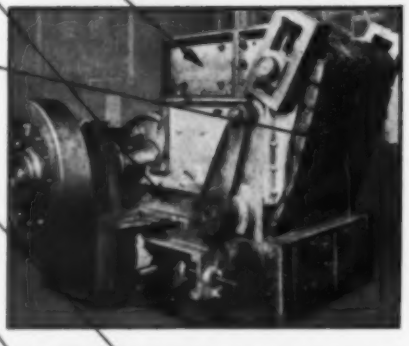
Step out holes in discs compensate for hammer wear.



Extra heavy special anti-friction bearings & housings.

Sectional construction makes every part easily accessable.

Side arm breaker plate adjusts for size of product.



Smoothly operating breaker plate. Especially designed sprockets and trunnion wheels.

Heavy cage bars; various openings for sizing materials.

All cast steel extra heavy frame for greater durability.

REMEMBER . . . there's only one Dixie. Don't be satisfied with anything less. For details request a copy of our helpful, informative bulletin, "More Efficient Crushing of Raw Materials." Write Dixie today.

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Foreign Office
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NEW YORK, N. Y.

* Dixie's Continuously Moving Breaker Plate . . . a vastly improved crushing principle exclusive with Dixie Hammermills . . . covered by U. S. Patents granted and pending.

Club, 52 East 41st St., New York, at the club's annual meeting last month.

Edgar A. Jett, II, has been named assistant director of Armour Research Foundation of Illinois Institute of Technology.

R. K. Toner has been promoted to associate professor of chemical engineering at Princeton University. He is also associated with the Textile Research Institute whose laboratories are located in Princeton.

Henry W. Rahn has been appointed research and development director for Southern Alkali Corp.'s Corpus Christi, Tex., plant. Mr. Rahn has been associated with Southern Alkali since 1934. He has been acting director of research and development during the past two years.

H. W. Rahn

E. H. Volwiler

Ernest H. Volwiler, executive vice president of Abbott Laboratories, has been elected as this year's recipient of honorary membership in Beta Gamma Sigma, scholastic fraternity in the College of Commerce, University of Illinois. He was chosen as a man "who has distinguished himself in the field of business." His initiation took place at a dinner in Urbana, Ill., last month.

Robert S. Aries and **Donald F. Othmer** of the Polytechnic Institute of Brooklyn departed for Europe on May 29. They are delegates to the centenary celebrations of the French Engineering Society in Paris, and will also visit for American interests, plants in Switzerland, Spain, western Germany and Sweden. Dr. Aries will address the respective societies of the chemical industry in Paris and Bruxelles, while Dr. Othmer will deliver a series of lectures in several Swiss universities.

George A. Watt has been made technical director of Griffith Rubber Mills, Portland, Ore. He was previously rubber chemist for Hewitt-Robins Corp., Buffalo, N. Y.

L. F. Perrine has been appointed to the newly-created post of paint department manager for Paraffine Cos., Inc., San Francisco. Perrine has been associated with various paint manufactur-

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FOR YOUR SPECIFIC REQUIREMENTS!

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STEEL STORAGE TANKS

Wherever liquids of any type are to be stored at atmospheric pressure, you'll find utmost economy and long-lived dependability in Steel Storage Tanks by Pittsburgh-Des Moines. Experienced design, careful craftsmanship in fabrication and erection, and a definite guarantee of satisfaction join to make the best of reasons for specifying "Pittsburgh-Des Moines." *May we quote on your storage needs?*

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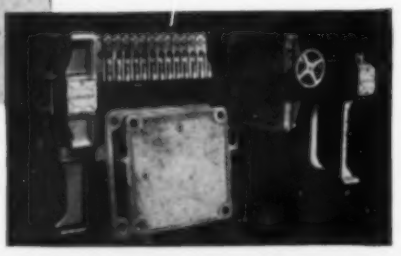
Meeting Every Filtration Problem

for Any Material at Any Pressure or Temperature

Whether it's recovery of solids; clarification or decolorizing of liquids; washing, heating or drying of filter cake; extracting, redissolving of cake or thickening of slurry, the Shriver Filter Press is the one equipment that can form any or *all* these functions in one filter to meet any physical or chemical conditions. Is there any other piece of processing machinery that can match such versatility? Let Shriver Filter Presses work for you! Write for Catalog No. 46.

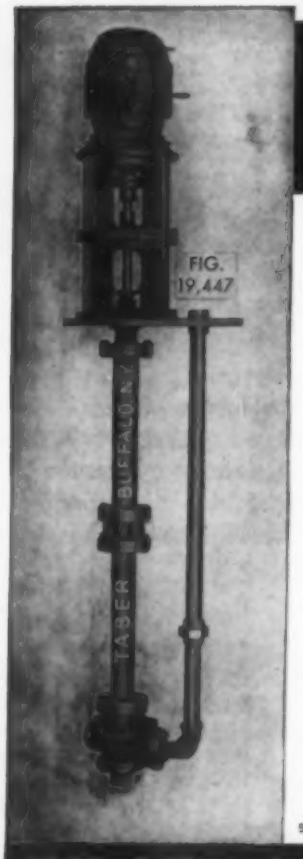
Large side feed, visible closed discharge, washing type stainless steel filter press.



Small double feed double discharge stainless steel filter press for operation to 750 p.s.i.

Corner feed, closed delivery, washing type stainless steel filter press.

T. SHRIVER & COMPANY, Inc., 802 Hamilton St., Harrison, N. J.



CHEMICAL FUMES ARE *SEALED IN!*

Fumes cannot leak through the stuffing boxes in Taber Vertical Pumps because the load liquid does not come into contact with these packings.

If your pump job is movement of concentrated sulphuric or other fluids, please write on your letterhead for a copy of our Special Bulletin V-837 which details the dependability of Taber Vertical Pumps for mounting in processing and storage tanks, or in vessels sealed against fumes or gases.

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ESTABLISHED 1859

TABER PUMPS for Higher Practical Performance

ers for 30 years. The new executive position is part of the firm's expanding paint manufacturing program.

H. C. Wiess, previously president of Humble Oil & Refining Co., was elected chairman of the board last month. **Hines H. Baker,** who has been executive vice president since 1945, was named to succeed Mr. Wiess. **Morgan J. Davis** and **C. E. Reistle** were elected directors of the company. Reistle is manager of production and is a chemical engineering graduate of the University of Oklahoma.

Harold Vagtborg has resigned as president of the Midwest Research Institute to accept a position with Tom Slick of San Antonio, Tex. Dr. Vagtborg is to remain at Midwest until July 1, and thereafter as consultant as long as demands in San Antonio and Houston permit. **George E. Ziegler,** executive scientist under Dr. Vagtborg, will carry on, pending the time a decision is made as to a permanent director.

William B. Brown, former director of research for the company, has been named manager of chemical production, Pittsburgh Coke & Chemical Co., and **William J. Zabor,** former director of research for the company's activated carbon division has been promoted to director of chemical development.

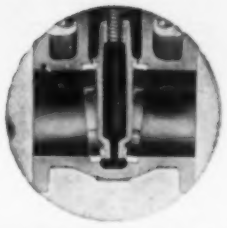
Charles L. Thomas, director of research of the Great Lakes Carbon Corp,. has been elected chairman of the Chicago section of the American Chemical Society. Dr. Thomas will assume office on July 1, succeeding **Herbert E. Robinson,** assistant director of research of Swift & Co.

Thomas C. Poulter has accepted a position with Stanford Research Institute, Palo Alto, Calif., as associate director. Dr. Poulter now holds the same position with the Armour Research Foundation of Illinois Institute of Technology, Chicago, and will go to the Pacific Coast later this year.

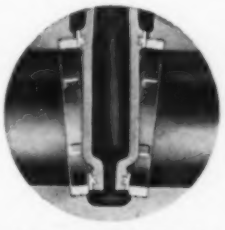
W. H. Kolins has been named superintendent of production for Frontier Chemical Co. He will supervise the manufacture of caustic soda and muriatic acid at Frontier's electrochemical plant at Denver City, Tex.

Lewis G. Bassett, Walter H. Bauer and **William H. Rauscher** have been promoted to full professorship in the chemistry department of Rensselaer Polytechnic Institute.

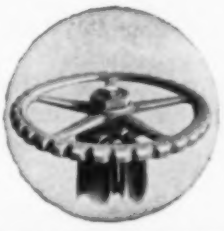
Edwin J. Cohn of the Harvard Medical School received the Theodore William Richards Medal of the Northeast-



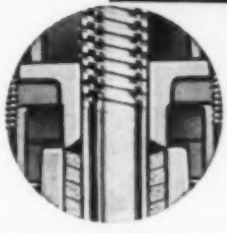
Straight-Flow Port Design reduces fluid turbulence to a practical minimum.



Seat Rings of end-seated type are screwed into the body.



Sure-Grip Malleable Handwheel for non-skid gripping even with heavy gloves.



Brass Liner on Glands assures greater resistance to corrosion and scoring.

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iron body gate valves

with screwed or flanged ends

... 8 Outstanding Features

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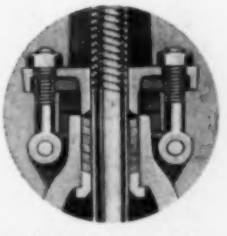
T-head Disc-to-Stem connection on OS&Y types provides stronger connection, prevents loosening of disc by corrosion.

Bronze Back-Seat Bushings in bonnets of OS&Y valves.

Solid Web Type Disc in OS&Y valves for greater strength and longer service.



Hinged Gland Eye-Bolts on OS&Y valves permit faster, easier repacking under full pressure.

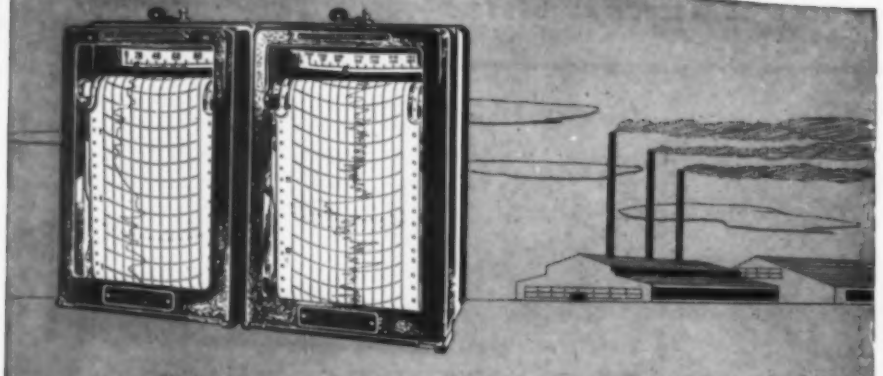
9 out of 10 industries Need Bendix-Friez Wind Recorders for Smoke Abatement Installations

Equipment for smoke and fume control is not complete without permanent records of wind-speed and direction. Write us about Aerovane.*

*TRADE MARK

Aerodynamic transmitter is easy to install and modern in design.

Wind speed, wind direction permanently recorded indoors.



FRIEZ INSTRUMENT DIVISION
OF BENDIX AVIATION CORPORATION
Baltimore 4, Maryland

Bendix AVIATION CORPORATION

ern section of the American Chemical Society last month. The presentation to Dr. Cohn cited his outstanding work on the physical chemistry of proteins.

OBITUARIES

James O'Connell, Jr., 59, branch manager of the Boston office of Innis, Speiden & Co., New York, and a company employee since 1910, died at Dedham, Mass., April 6.

Swen W. Nelson, manager of the Buffalo office of Bailey Meter Co., died April 12.

Clifford E. Wheeler, 52, consulting chemical engineer, died at Malden, Mass., on April 14.

William A. Peters, Jr., vice president of E. B. Badger & Sons Co., Boston, Mass., lost his life in an airplane crash in Eire on April 15.

Arthur Wright, 60, president of Arthur Wright Associates, chemical engineering consultants of Montclair, N. J., died at his home April 19.

E. Hugh Long, 63, former vice president in charge of sales for Sharp and Dohme, Inc., died in Philadelphia April 20.

Lloyd Cady Daniels, 65, assistant technical director of general technical division, American Cyanamid Co., died in New York April 21.

Mark Wilder Bray, 58, chemist in charge of alkaline pulping investigations in the pulp and paper division of the U. S. Forest Products Laboratory at Madison, Wis., died April 24.

Harvey Elwell, 54, president of the General Latex & Chemical Corp., died at Newton, Mass., April 30.

Frank O. Clements, 73, first director of the General Motors research laboratories, died in his home at Westerville, Ohio, May 8.

Ralph E. Dorland, 69, New York manager of the Dow Chemical Co., died in New York May 14.

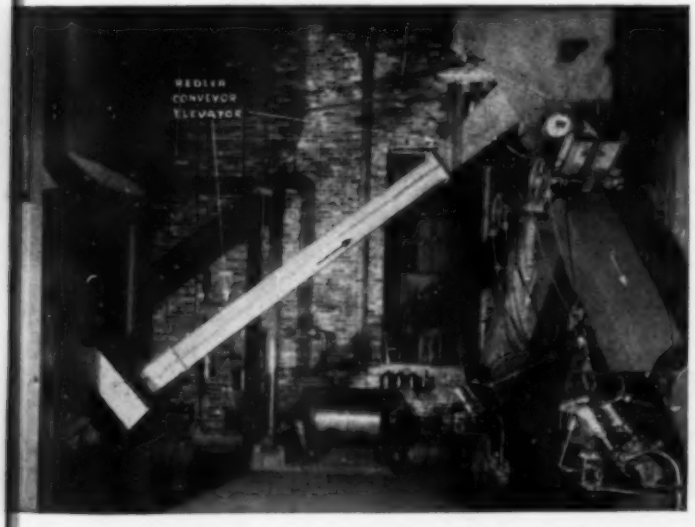
Wilton H. Gage, 85, who was active in the glue industry throughout his life, died at his home in St. Louis May 16.

Joseph J. Mattiello, 48, industrial chemist, authority on protective coatings, and vice president and a director of the Hilo Varnish Corp., died at his home in Brooklyn on May 16.

How S-A bulk material handling systems cut costs, solve problems in many fields

CLEAN, gentle handling is assured for the grain processed in this plant. The weather-tight REDLER feeds itself a uniform load at the railroad track, elevates to the third floor, and discharges to various bins . . . in a single, compact conveyor unit . . . without contamination, spillage or dust. Write for more information on S-A conveyor systems for food products.

2-IN-ONE Sorting Conveyors with end sections hinged, to lower clean coal into cars, with minimum breakage at this Indiana preparation plant. The S-A pan conveyors shown, permit removal of slate and foreign materials. Another conveyor beneath disposes of the refuse. Write for information on S-A conveying and screening equipment for handling coal, ore, and stone at lowest cost.



NO DIRT. Coal dust has been eliminated from many boiler rooms with compact, dust-tight REDLER conveyor units like this. One conveyor draws coal from storage, elevates, and fills several stoker hoppers. In other cases, closed-circuit REDLERS store and reclaim from any part of large storage bunkers. Write for suggestions on a compact, economical conveyor system for your power plant.

VOLUME, reliable operation and low maintenance for many years was guaranteed for this S-A belt conveyor by the use of "Pacific" carriers. Timken tapered roller bearings take the punishment of heavy loads of stone and gravel. Pressure lubrication and labyrinth seals protect from dirt and weather. Write for data on S-A belt conveyors for dependable, large volume, low cost handling.

STEPHEN S-A ADAMSON MFG. CO.

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BULK MATERIAL HANDLING EQUIPMENT

Magic pulse!

Line error is completely eliminated in AMERICAN Mercury Actuated Dial Thermometers with the new *magic pulse* self-compensating capillary tubing which automatically corrects for ambient temperatures along the line.

The comprehensive AMERICAN line of Vapor, Gas and Mercury actuated Dial Thermometers—each built for a specific purpose—has represented the ultimate in accuracy and durability for nearly a century.

The *magic pulse* self-compensating tubing now permits a wider application of the advantages inherent in mercury actuation. A Manning, Maxwell & Moore field engineer is available in your locality to demonstrate this new feature and help you select the correct instrument for your particular service.

Visit our Booth at the Third National Instrument Exhibit, Convention Hall, Philadelphia, Pa., Sept. 13-17.

American Glass, Dial and Recording Thermometers are sold by leading distributors everywhere. Write to them or to us for information.

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Makers of 'American' Industrial Instruments, Hancock Valves, Ashcroft Gauges, Consolidated Safety and Relief Valves. Builders of 'Shaw-Box' Cranes, 'Budgit' and 'Load Lifter' Hoists and other lifting specialties.

INDUSTRIAL NOTES

Borden Co., New York, has amalgamated the Casein Co. of America and the Durite Plastics Division under the single name of the Chemical Division. Personnel and management remain unchanged.

Reliance Electric & Engineering Co., Cleveland, has elected W. R. Hough engineering vice president.

Interchemical Corp., New York, has added Albert J. Capalbo to the flexible plastic coatings department of the finishes division.

Titanium Alloy Mfg. Co., Niagara Falls, N. Y., has appointed Warren Blumenthal chief of the chemical research division.

Publicker Industries Inc., Philadelphia, has appointed Frank E. Bennett sales manager for Publicker Alcohol and Chemical Sales Corp., subsidiaries.

Raybestos-Manhattan, Inc., Passaic, N. J., has elected John F. D. Rohrbach president succeeding Sumner Simpson.

Tennessee Products and Chemical Corp., Alton Park, Tenn., will carry out a $1-million expansion program at its Alton Park operations. The program includes the erection of two new plants; one to augment the production of ferrosilicon essential in the manufacture of steel, and the other to increase the company's output of fine chemicals.

Westvaco Chemical Corp., New York, is the new corporate name of the former Westvaco Chlorine Products Corp.

Spencer Chemical Co., Kansas City, is building a formaldehyde plant in the Greater Chicago area. Initial production is planned for late 1948. Harold R. Dinges is now chief of sales for Spencer's chemical and fertilizer divisions.

H. K. Porter Co., Inc., Boston, has appointed Lawrence A. Franks manager of the Boston District Office.

Allis-Chalmers Mfg. Co., Milwaukee, elected Walter Geist to his seventh term as president. All directors and officers were re-elected.

Libbey-Owens-Ford Glass Co., Toledo, has added Theodore O. Woldt to the sales force of the Plaskon Di-

MULTI-METAL
WIRE CLOTH
WOVEN
TO FIT YOUR NEEDS
For Filtering, Sifting, Screening

Available by the roll or by the cut piece

Wide variety of meshes, weights, sizes and metals, also fabrication operations requiring high standards of accuracy and durability.

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More than 35 years of service to process industries

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WIRE CLOTH COMPANY, INC.
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FREE AIR?

NOT ON YOUR LIFE!!

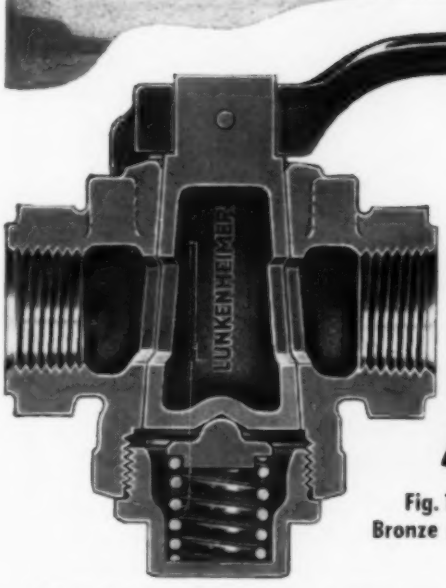

Fig. 1571
Bronze Air Cock

COMPRESSED AIR is a Valuable Tool . . . but costly if wasted!

SAVE IT with LUNKENHEIMER Air Devices

That h-i-s-s-s-s-s you may hear around your air lines means there's a villain loose in your plant. Costly compressed air is escaping, costing you money by the minute. But, you say . . . "it's only a pinhole, can't amount to much." Look at the chart below.

A SMALL LEAK MAY COST YOU AS MUCH AS $5.82 A MONTH.

AREA OF LEAK	AIR	
Diameter Inches	Number of cubic feet per month at 75 lb. pressure	Total cost of waste per month 11c per 1000 cubic feet
1/4"	3,366,990	$370.37
1/8"	824,570	$90.70
1/16"	213,000	$23.43
1/32"	52,910	$5.82

Check your plant . . . compressed air leaks mean that good dollars are "gone with the wind." Replace leaky or defective air devices with LUNKENHEIMER Air Cocks, Valves, Nozzles. Designed for air line service, LUNKENHEIMER Air Devices seat tight and stay tight, requiring minimum maintenance for long, efficient service life.

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Stop those air leaks now. Your Lunkenheimer Distributor has a stock of Cocks, Globe and Angle Valves, Nozzles, Safety Valves, Check Valves, Tips, Nipples and other fittings for your needs. *Write for Circular No. 587 and enlarged copy of air leak chart, suitable for posting.*

Fig. 1840
Air Nozzle
Available with
various tips.

Fig. 1227
Pop Safety Valve
for Air

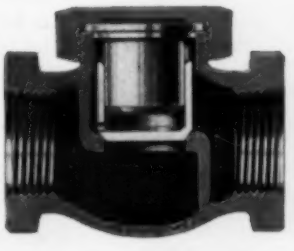
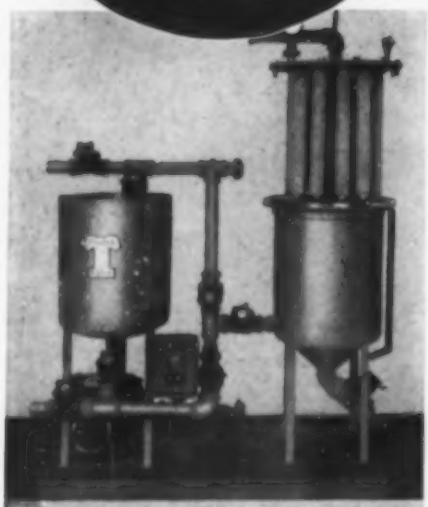


Fig. 1616
Air Compressor
Check Valve...
Hollow Stainless
Steel Disc

Fast cleaning time



TITEFLEX Filter Model 5A 1000 showing porous membrane.

One of the many economies of the **Titeflex** *Filter*

CLEANING of the TITEFLEX Industrial Filter requires only 7 to 20 minutes, depending upon the size of filter and type of solution being filtered. A new method of backwashing simplifies the entire cleaning process, eliminates waste labor, and completely removes all residue.

Other important savings made possible by the TITEFLEX Filter are:

1. LOW MATERIAL COST—a few cents worth of filter aid serves for each batch filtered. No expensive filter pads or asbestos sheets.
2. LOW LABOR COST—a completely sealed system requiring a minimum of labor.
3. LARGE CAPACITY—3 to 10 times that of the other equipment with equal filtration area.
4. NO LEAKAGE—therefore no loss in expensive filtered material.

If you are looking for a highly efficient filter that will give you sharp, clear filtration at the lowest possible cost, then investigate the TITEFLEX filter. Write for descriptive folder—today.

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Exclusive Manufacturers of Titeflex high quality products for more than 30 years

Sales Offices { CHICAGO CLEVELAND DETROIT PHILADELPHIA LOS ANGELES BOSTON SAN FRANCISCO TORONTO

vision. He will handle sale of synthetic coating resins in the Chicago area.

Sumner Chemical Co., Inc., Zeeland, Mich., is the new name of the former Chemical Specialties Inc. It is owned by Miles Laboratories, Inc. The change coincides with the appointment of Ralph L. Ericsson as sales manager. He will be located in the newly opened New York office.

Link-Belt Co., Chicago, has opened a district sales office in Albany, N. Y., headed by J. Charles Bullock.

Roots-Connorsville Blower Corp., Connersville, Ind., has opened an office in Cleveland headed by Franklin F. Bogardus.

Koppers Co., Inc., Pittsburgh, has appointed John H. Redmond as assistant production manager.

General Electric Co., Pittsfield, Mass., has appointed H. Arthur Howe as manufacturing manager of the compound division.

General Aniline & Film Corp., New York, has added the following men to the staff of the central sales development department: D. A. Beadell, D. E. Sargeant, W. M. Shine, Aubrey H. Nease, C. F. McKenna, Jr., and Henry C. Speel.

Allis-Chalmers Corp., Milwaukee, has elected James M. Barker director. W. C. Johnson and W. A. Roberts were elected to the executive committee.

Davison Chemical Corp., Baltimore, has secured a ten-year loan of $5,000,000 from the Metropolitan Life Insurance Co. to refund bank loans incurred during its recent expansion program.

Crocker-Wheeler Electric Mfg. Co., Ampere, N. J., has appointed C. Porter Packard as district manager of the Boston office.

Dow Corning Corp., Midland, Mich., has appointed R. B. Ehlers to direct a newly opened Atlanta, Ga., branch office.

Libbey-Owens-Ford Glass Co., Toledo, has named George B. Rheinfrank, Jr., manager of market analysis at Plaskon Division.

Pioneer Rubber Co., Willard, Ohio, has elected J. C. Gibson chairman of the board. J. H. Gibson was elected president and treasurer. Other newly elected officers are C. R. Clark, vice president and general manager, and

NEW CESCO CATALOG

tells you Where to use . . . How to use . . . and How to Select Industrial Protective Equipment

● This **NEW** CESCO Catalog is "industry's guide to accident reduction." That's what safety men who have seen it say. It completely explains and illustrates how to buy and how to use industrial protective equipment. All technical information is based on reports from impartial experts. Much of it applies to all protective equipment, regardless of make.

***64 PAGES** of ammunition against industrial accidents! Sixteen pages explaining correct safety procedures . . . over 150 protective items are illustrated and described throughout the book.*

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Oil Cooled POWERSTATS

INCREASED SAFETY INCREASED POWER

The immersion and mounting of a POWERSTAT variable transformer in oil can substantially increase its rating above normal air operation. The increased power is dependent upon the type of POWERSTAT, quantity of oil, area of wetted surface and type of container. In addition, POWERSTATS mounted in oil are ideally suited for use in hazardous areas such as powder mills, gas reduction chambers, oil and gas refineries and similar locations where a small arc or spark could cause an explosion.

Most POWERSTATS can be adapted for oil mounting, but since applications vary, only single phase types are available as standard. However, The Superior Electric Company can provide in quantity specific oil-cooled POWERSTAT requirements.

Oil-cooled POWERSTATS are quality manufactured and ruggedly designed to stand the severest usage, providing precision control with added power and safety for dependable, accurate service.

Any problems regarding the use of oil-cooled POWERSTATS should be referred to The Superior Electric Company's staff of experienced voltage control engineers. Use their specialized knowledge.

Write The Superior Electric Company, 206 Meadow Street, Bristol, Connecticut

Request Bulletin 547, a completely illustrated voltage control engineering data catalog.

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Test Viscosity

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WHEN IT COUNTS THE MOST

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VISCOMETER

At last, Point of Process Viscosity readings are not only practical, but simple, rapid, and accurate as well. The Brookfield Viscometer is portable and plugs into any ordinary electrical outlet for connection. Operation is completely automatic and readings are given directly in centipoises.

ONLY A BROOKFIELD HAS ALL THESE ADVANTAGES

- Portable — use in lab and plant
- Rapid — readings in 30 seconds
- Accurate — within 1% of range
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Please send me your new 8 page booklet describing and illustrating the various Brookfield Models and their uses.

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L. F. Pagel, assistant secretary and superintendent of production.

Hall Laboratories, Pittsburgh, has added Leonard Highley, Jr., to the Pittsburgh home office; G. Howard Smith to the Birmingham district office; and Robert G. Hobek to the Cincinnati district office.

Dixie Chemical Co., Houston, is spending $60,000 to expand its manufacturing operations at Houston. The company has bought a 15-acre tract which will be used for the production of petroleum sulphonate, oil field chemicals and other materials. James T. Clarke, a vice president of the company, will be in charge of operations.

De Laval Separator Co. has elected George C. Stoddard president. E. Gray Merrill has been elected vice president and T. H. Walworth has been elected treasurer.

Allen-Bradley Co., Milwaukee, has moved its Detroit office to larger quarters at 11100 East Warren Ave.

Hukill Chemical Corp., Cleveland, has been appointed agent for the Haeser Shellac Co., Brooklyn, N. Y., in the Cleveland and northern Ohio area.

American Cyanamid Co., Bound Brook, N. J., has appointed D. M. Aumack manager of the newly created effluent department of its Calco Chemical division.

Timken Roller Bearing Co., Canton, Ohio, has made George Reed a sales engineer of its steel and tube division, with headquarters in Houston.

A. O. Smith Corp., Milwaukee, has appointed L. M. Keating executive administrator of its southwest district office in Houston.

Stephens-Adamson Mfg. Co., Aurora, Ill., has moved its Pittsburgh offices to 1408-9 Investment Bldg., 237 Fourth Ave.

SKF Industries, Inc., Philadelphia, has made its Charlotte, N. C., branch office a district headquarters for North and South Carolina, southern Virginia, eastern Tennessee and northern Georgia.

Portland Cement Assn., Chicago, has appointed A. M. Davis manager of its midwestern offices.

Mathieson Chemical Corp. is the new name of the Mathieson Alkali Works, New York. Stockholders ap-

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SWEET'S FILE

One hundred and ninety-five manufacturers' catalogs—1,520 catalog pages—instantly accessible in the 1948 Sweet's File for the Process Industries. There, right in your office, you will find up-to-date, useful and comprehensive information on forms, characteristics, performance and use of a wide range of materials, equipments and services.

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Trentweld

STAINLESS STEEL TUBES pay for themselves in TIME

They save TIME *by the hour* in installation
They gain TIME *by the year* in length of service

Today, time runs into money, more money than ever before. If you agree with this, then the advantages of Trentweld stainless steel tubes are for you . . . for here is heat exchanger tubing, made to specifications that cut costs — all costs.

To begin with, Trentweld tubes are thin-walled and have a soft temper. They roll or weld into tube sheets easily. All tolerances are held to micrometer limits to provide pressure tight joints easily. They go in fast, makes a smooth-running, time-saving job of installation. More than that, all Trentweld tube is pressure-tested, is pickled for increased corrosive resistance and is flare-tested for ductility. Back of these precision standards is an exclusive method of rolling and fabricating stainless tubing that gives Trentweld performance stamina not to be found anywhere else.

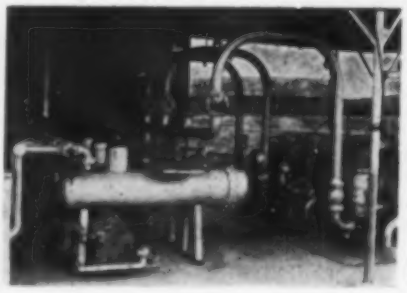
These are only the highlights on this work-horse tube. All of the facts are yours for the asking. Call on Trentweld engineers, without obligation, for specific information, or write for the Trentweld Data Bulletin.

District Offices—New York, Chicago

TRENTWELD STAINLESS STEEL TUBES

TRENT TUBE MFG. CO.

420 Church Street, East Troy, Wisconsin



EXCEL-SO

SEPARATORS

Solve the Problem

3-HP-300 (300 gpm) 150# w. p. SOD EXCEL-SO Separators filtering pipe scale and removing water from products pipe line. Note air eliminator domes and mechanisms now built into separators, where required. Massachusetts Pipe Line Co., Everett, Mass.

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BOX 3096C TULSA, OKLAHOMA

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Please Send Complete Information On Excel-So Separators

EXCEL-SO

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Street _____

City _____

proved the change in name last month. The company has considerably broadened its operation and the new name is more descriptive of operations. It was originally founded in 1892 to produce alkali and bleaching powder.

Warren Petroleum Corp., Tulsa, Okla., has elected Don M. Mattocks secretary.

Wheatland Tube Co., Philadelphia, has made the Wilkoff Chemical Export Co. export sales agent for the products of its affiliates, the Maneely-Chemical Co., Maneely is constructing a new plant at Wheatland, Pa.

Sawyer Bailey Corp., Buffalo, N. Y., has purchased the assets of the Buffalo Turbine Corp.

Diamond Alkali Co., Cleveland, has moved its executive offices from Pittsburgh to Cleveland.

American Car and Foundry Co., New York, has appointed William H. Schuster welding supervisor.

American Brake Shoe Co., New York, has appointed Joseph P. Kleinkort general sales manager of its Ramapo Ajax Division.

Elliott Co., Jeannette, Pa., has appointed John W. Anne sales manager of its plant.

Processing Industries, Inc., New York, has named K. E. Woetzel to direct development of its interests in the field of chemical industries.

Dow Chemical Co., Midland, has transferred Edmund Mann from its Cleveland office to St. Louis.

American Car and Foundry Co., New York has appointed Frederick H. Norton vice president in charge of all sales.

Lukens Steel Co., Coatesville, Pa., has added Glenn L. Johnson to its sales development staff.

F. J. Stoakes Machine Co., has made F. J. Stoakes chairman of the board. Francis Dougherty, Jr., succeeds him as president.

General Ceramics & Steatite Corp., Keasbey, N. J. has elected Robert W. Ferguson a director and president.

American Cyanamid Co., New York, has appointed James L. Rodgers, Jr., general manager of its new plastics and resins division.

MONARCH CORROSION RESISTANT NOZZLES Of

Fig. F-80

STAINLESS STEEL:
Available in capacities from .57 G.P.H. Fig. F-80 style illustrated, to 104 G.P.M. (Fig. B-8-A style). .

"Hollow" cone, "Solid" cone, and "Flat" sprays furnished in pipe sizes and capacities to suit practically any problem where corrosive liquids are sprayed

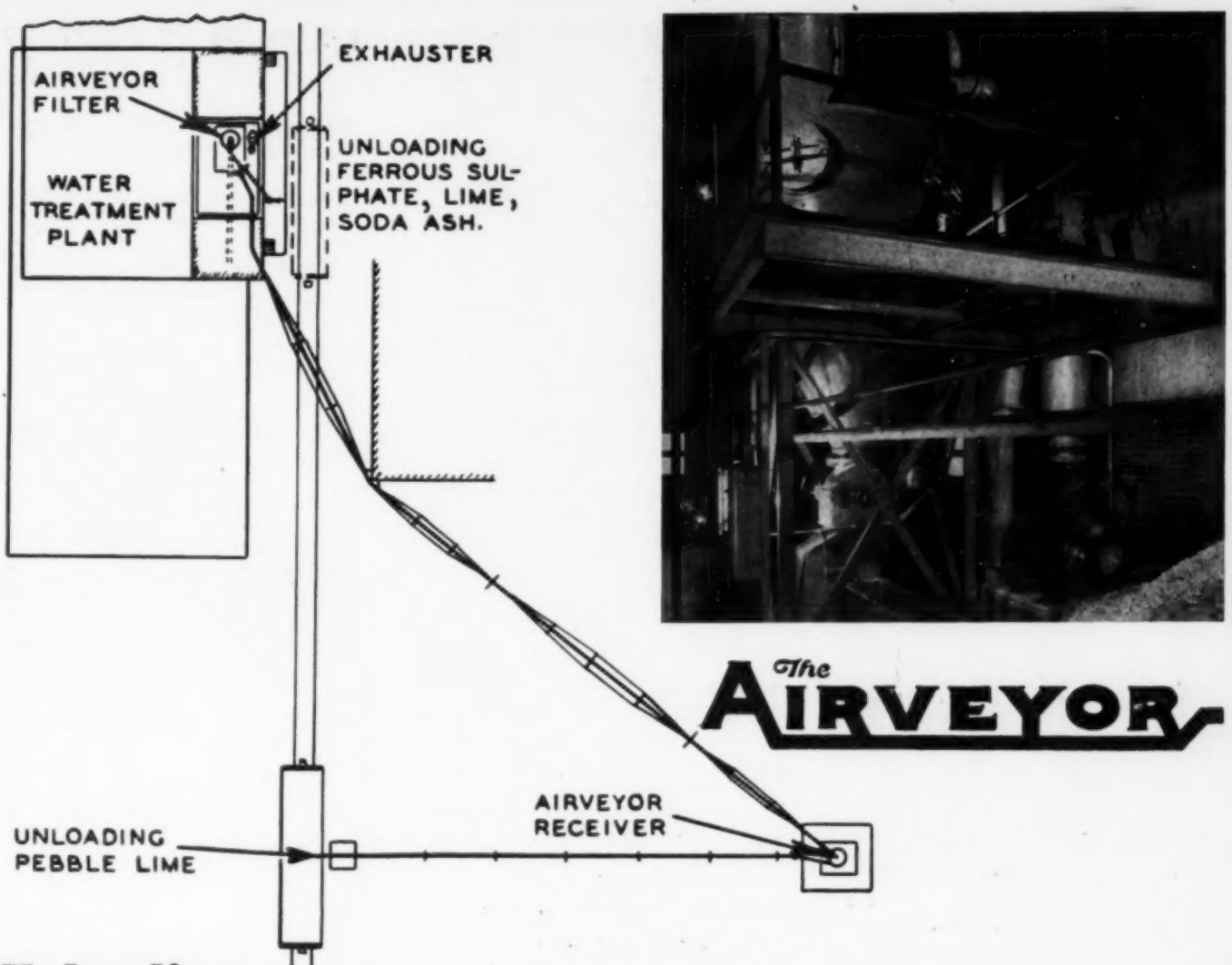
STONEWARE:
Monarch Fig. 6020 and Fig. 6040 stoneware sprays have replaced most other types of nozzles used in acid chamber plants throughout the world. Last almost indefinitely in sulfur gases and will not break or crack from temperature changes.

HARD RUBBER:
Patented Fig. B-27 nozzle is of the "non-clog" type, i.e. it contains no internal vanes, slots, or deflectors which might facilitate clogging. Available ¼" to 1" pipe. Small sizes produce a very fine, soft, wide angle hollow cone spray, even at low pressures.

Fig. H-407 "flat" spray produces a relatively fine even sheet of liquid.

Write for Catalogs 6A and 6C

MONARCH MFG. WKS, INC.
2513 E. ONTARIO ST.
PHILADELPHIA 34, PA.



The AIRVEYOR

Unloading . . .
FERROUS SULPHATE, LIME, SODA ASH

As illustrated, a rubber-processing plant employs the Airveyor for handling dry bulk chemicals. There are two box-car unloading stations, one for the unloading and conveying of pebble lime to storage for use in the manufacturing process; the other for unloading ferrous sulphate, soda ash and lime for a water-treatment plant.

One exhauster serves the two systems. In the pebble lime unloading station, a two-stage cyclone receiver is used, the fine dust being taken care of by the filter in the water-treatment plant through an air-return line from the receiver. This filter is equipped with cloth tubes which are automatically shaken at regular intervals for removal of dust. This filter is used when unloading the three bulk chemicals in the water-treatment plant. The system has an unloading capacity of 7½ tons an hour. Maximum conveying distance approximately 216 feet.

The photograph shows the Airveyor filter in the water-treatment plant. Directly underneath the cone of the filter is a rotary airlock feeder which discharges the material to a screw conveyor for delivery to storage. The exhauster and motor are to the right of the feeder. Directly above the platform, right, is the two-way pipe switch used in connection with the air-return line when unloading pebble lime direct to the receiver.

The Airveyor saves the difference in price by purchasing in bulk instead of bags; cost of unloading and storing bagged material. Other advantages are—clean and dustless operation, rapid unloading, minimum of labor, and convenience in storing and reclaiming.

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FULLER-KINYON, FULLER-FLUXO AND THE AIRVEYOR CONVEYING SYSTEMS . . . ROTARY FEEDERS AND DISCHARGE GATES . . . ROTARY AIR COMPRESSORS AND VACUUM PUMPS . . . AIR-QUENCHING INCLINED-GRATE COOLERS . . . DRY PULVERIZED-MATERIAL COOLER . . . AERATION UNITS . . . MATERIAL-LEVEL INDICATORS . . . MOTION SAFETY SWITCH . . . SLURRY VALVES . . . SAMPLERS

A-83

ASK ANY OF THE
Big Paper Mills

Speaking of ground water . . . When the record shows an almost 100 percent exclusive use of Layne Well Water Systems for the entire United States and Canadian paper mill industry, it is time for the Layne Organization to take a bow. But such is the case and that enviable fact is due to Layne's consistently maintained top flight quality, high efficiency and the important KNOW HOW of modern well water system construction.

Day after day and year after year, Layne Well Water Systems continue to produce the 40 tons of water required in the making of each ton of paper. It is these same kind of well water systems that Layne builds for railroads, petroleum plants, packing houses, breweries, air conditioning installations, chemical plants, irrigation projects, municipalities—or in any situation where huge quantities of water must be produced at extremely low cost.

No other well water systems are as widely used or highly praised as those bearing the name Layne. For literature, address Layne & Bowler, Inc., General Offices, Memphis 8, Tennessee.

LAYNE WELL WATER Systems

AFFILIATED COMPANIES: Layne-Arkansas Co., Stuttgart, Ark. • Layne-Atlantic Co., Norfolk, Va. • Layne-Central Co., Memphis, Tenn. • Layne-Northern Co., Mishawaka, Ind. • Layne-Louisiana Co., Lake Charles, La. • Louisiana Well Co., Monroe, La. • Layne-New York Co., New York City • Layne-Northwest Co., Milwaukee, Wis. • Layne-Ohio Co., Columbus, Ohio • Layne-Pacific, Inc., Seattle, Wash. • Layne-Texas Co., Houston, Texas • Layne-Western Co., Kansas City, Mo. • Layne-Western Co. of Minn., Minneapolis, Minn. • International Water Supply Ltd., London, Ont., Can. • Layne-Hispano Americana, S. A., Mexico, D. F.

CONVENTION PAPER ABSTRACTS

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Dolomite Potentialities

IMMENSE deposits of dolomitic limestone close to the surface in western Ohio can be processed on a commercial scale to produce both lime and magnesium.

Estimated 1947 consumption of common limestone by producers of alkali chemicals, was just under six and a half million tons. If dolomite were used instead, the potential volume of magnesium made available would amount to about 800,000 tons.

The large shaft kilns in which the dolomite is burned are lined with bricks made of a form of magnesium that withstands temperatures above 3,000 deg. Such super-duty fire bricks hold up even at temperatures developed by the new practice of injecting oxygen into steel making furnaces to increase their capacity.

C. C. Brumbaugh, Diamond Alkali Co., before American Institute of Chemical Engineers, Cleveland, May 10, 1948.

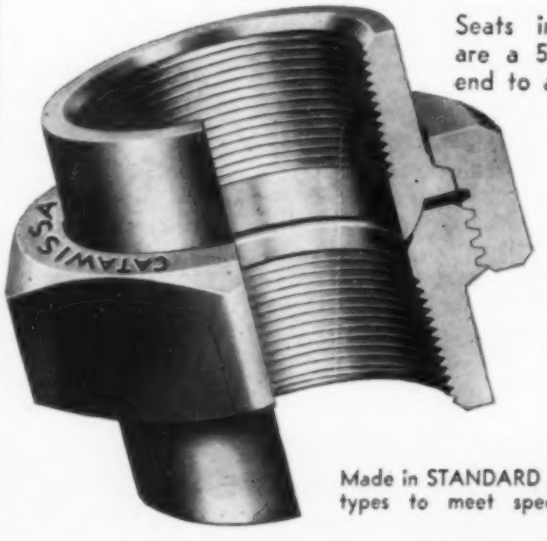
Bug Problems

MORE GOOD insecticides have been developed than science knows how to use efficiently and safely. In recent years economic entomologists have spent a large part of their time on comparative spray tests of many new chemicals. Consequently, they have amassed a large amount of toxicological information indicating that these new compounds have high insecticidal efficiency. As yet they do not know how, or when or where these chemicals may be economically and safely used.

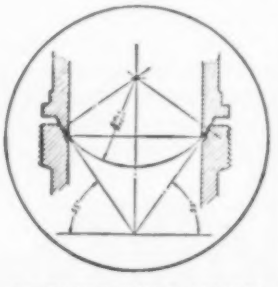
A mixture of DDT, benzene hex-

CATAWISSA Unions give you a PERFECT SEAL
even when the pipe is not in perfect alignment!

● HOT FORGED STEEL
● STAINLESS STEEL



Seats in all Catawissa Unions are a 55° angle on the female end to a BALL on the male end —assuring good, tight, leakproof joints!



Made in STANDARD and DOUBLE EXTRA HEAVY types to meet specific pressure requirements!

Double Extra Heavy
Hot Forged Steel
SWING CHECK VALVES

write for your copy of BULLETIN 10-A

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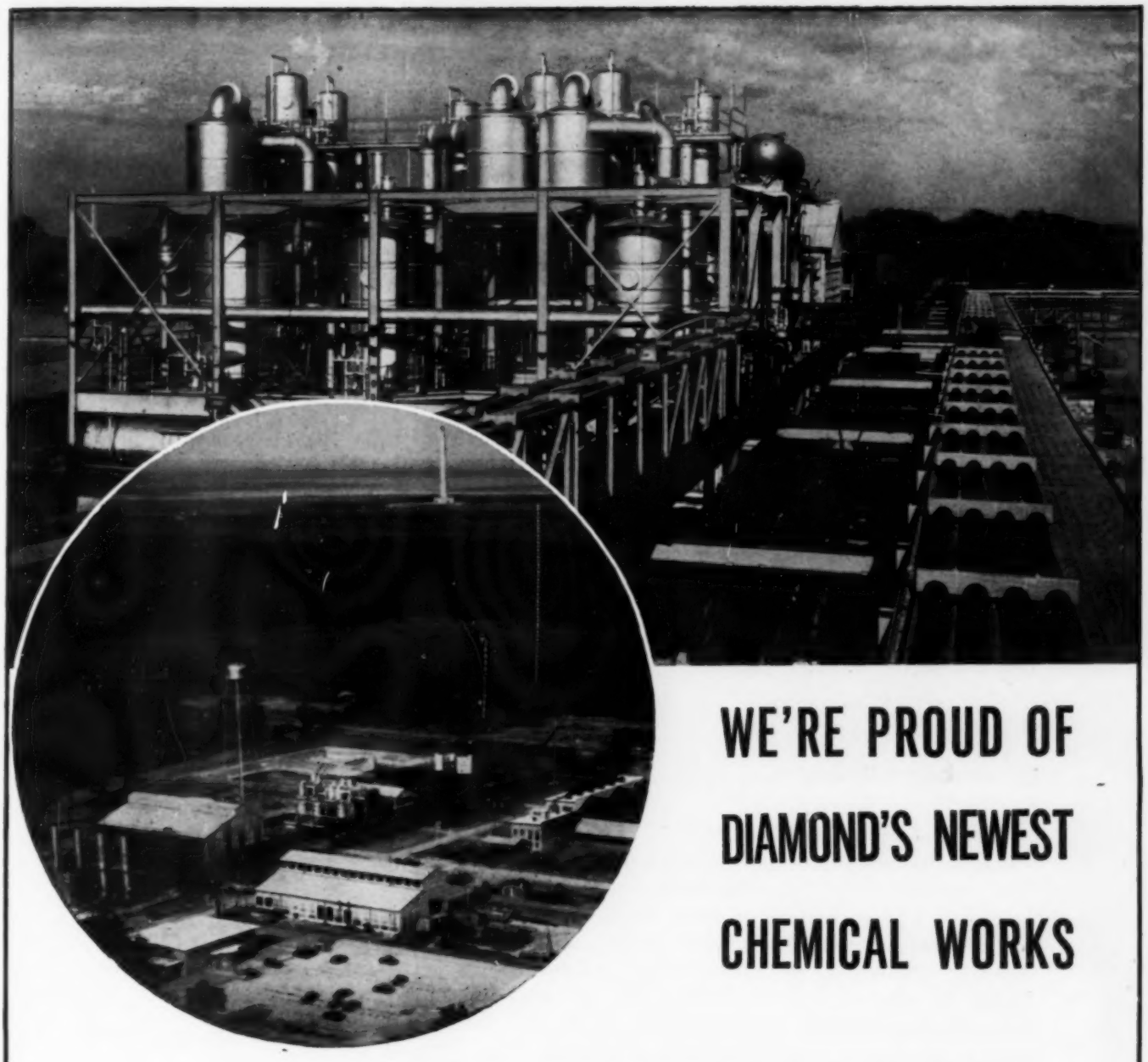
100 Mill St. · CATAWISSA, PA.



WE'RE PROUD OF DIAMOND'S NEWEST CHEMICAL WORKS

Diamond Alkali Company's newest chemical plant, the Houston Works on the Houston Ship Channel, recently went on stream, manufacturing chlorine and caustic for what it's able young president, R. F. Evans, so aptly described as "the living, growing, expanding chemical industry." Brown & Root, Inc. are proud to have been selected for engineering and construction of this great plant—proud of the part we have in the process industry in the Southwest, which is fast securing its position as a world chemical capital.

BROWN & ROOT, Inc.

P. O. Box 2634 Houston 1, Texas

Giant
sizes up to
MAGNILASTIC EXPANSION JOINTS are now standard in all pipe sizes up to 72 inches, and are available in a large-diameter low-pressure series to 120 inches. In repairs, replacement, or new construction, MagniLastic units can cut costs by eliminating expensive custom models, bulky installations, costly maintenance, short life, fractured piping.
MagniLastic has pioneered in standardizing a complete line of packless expansion joints for almost all pipe-movement requirements, including pressures from vacuum to 1000 psi and temperatures from minus 300° to plus 1600°F. Joints are made of Stainless Steel, Monel or any weldable alloy to fit customers' operating conditions.
Request our new catalogs for your engineering and maintenance departments from nearest MagniLastic distributor, or write us direct, specifying Catalog 255 and number of copies.
MAGNILASTIC
division of COOK ELECTRIC COMPANY, Chicago 14
"There is a MagniLastic Expansion Joint for every piping need"

achloride and sulphur holds promise of greatly increased cotton yields because of its deadly effect against the boll weevil. However, it is too early to tell exactly what result the wholesale adoption of this chemical control and of recently developed mechanical cotton pickers will have on the economy of the cotton states.

Studies of benzene hexachloride have indicated, that as little as 0.5 lb. per acre of one of its forms will eradicate many types of harmful insects living in the soil and feeding on roots of valuable crops. Unfortunately, this chemical has been absorbed by such plants as potatoes and given them an objectionable flavor.

DDT has found widespread use in the control of the codling moth in apple orchards, but it has not solved the red mite problem. Although DDT has proved an effective and cheap weapon against many insects, it is no cure-all as was commonly supposed during and immediately after the war. It has probably created as many new insect problems as it has solved.

It does not control many species of harmful insects and related pests, and lately the question of its accumulation in soils has arisen. These and many other problems still confront the research entomologist regarding the use of DDT.

T. Walter Reed, California Spray-Chemical Corp., before American Chemical Society and American Institute of Chemical Engineers, Bristol, Va., May 7, 1948.

Hydrogen Chloride Absorption

While hydrogen chloride is extremely soluble in water, its absorption is complicated by its high heat of absorption which is 700 Btu. per lb. of HCl in 35 percent acid compared with the 1,000 Btu. per lb. heat of evaporation of water. These relations are such that when absorption is started with water initially at 86 deg. F, the acid begins to boil and absorption ceases when its strength reaches 14.5 percent HCl by weight. In order to produce acid stronger than 14.5 percent, the acid must be cooled so as to lower the partial pressure of HCl in the acid.

One of the four following methods or a combination of them can be used: (1) Sensible heat exchange with the surroundings, usually cooling water; (2) evaporation of water from the acid; (3) sensible heat exchange with the gas stream; (4) change of heat content of product acid compared with feed water and gas streams.

Accordingly, the experience of the industry up to 1927 led to the adoption of three general types of equip-

Go Lead for Acid Valves

When you want acid valves that will stay on the go . . . *Go National for Lead!*

In many process plants, lead has proved that it is *first* choice for making acid valves *last*. National Lead brings you lead's many advantages, engineered into a complete line of valves.

Here are just a few of the types ready to help you fight acid corrosion:

1. "United" Type R Valve. This "many-purpose" valve features a split body and removable seat. As a result, it offers advantages unobtainable with valves whose body and seat are cast integrally.

The split-body construction permits use as either a "Y" or Angle pattern. All you do is reverse the position of the body section as shown in the illustration below. By standardizing on *one* valve with *two* uses you hold your supply stock to a minimum.

Then, too, the removable seat and plug disc can be replaced easily at nominal cost. Finally, seat and plug can be supplied in any alloy or material you specify.

For normal applications the valve is available three standard ways: 1. Lead plug disc and stem integral; 2. Replaceable lead plug disc; 3. Replaceable rubber and plug disc.

***One valve does two jobs!** Reverse the position of the body sections, and the "United" Type R valve is changed from an Angle pattern to a "Y" pattern. Available in hard lead or lead-lined cast iron or cast steel.*

2. "United" Chem-Rayon Valve. The body of this valve is cast hard lead. Fins of the same metal reinforce and greatly increase the strength of body and flanges, while holding weight to a minimum.

The stuffing box is of exceptional depth. Packing can be replaced under pressure. Steel and bronze bonnet are completely covered (except wheel and bushing) with hard lead. Manufactured in both "Y" and Angle design. Available with removable plug discs of rubber or lead.

3. "United" Type C Valve. The important difference between this type and the "United" Chem-Rayon valve lies in the materials used for body and bonnet. In the Type C valve these are made of cast carbon steel or cast iron, heavily lined with lead. The body is cast oversize in order to allow a full flow after lining. All parts of the two valves are interchangeable. Available in both "Y" and Angle patterns.

4. "United" Gate Pattern Valve. Here's a most efficient gate valve, available with body and bonnet in hard lead, lead-lined cast steel or lead-lined cast iron. It is designed to provide full area and unrestricted flow with minimum friction loss. The seat is hard lead, cast integrally with the body lining. This valve can be furnished with disc made of acid-resisting rubber, bakelite or special alloys as required. You get a satisfactory seal at all times.

We also supply check, foot and diaphragm valves in hard lead, cast iron, and cast steel, lead-lined.

Go National for Lead

. . . pipe . . . valves . . . sheet . . . lead-lined or lead-covered equipment . . . even complete acid recovery plants. Behind every National Lead recommendation, every National Lead product, are years of experience and many important installations in every field handling corrosive liquids and gases.

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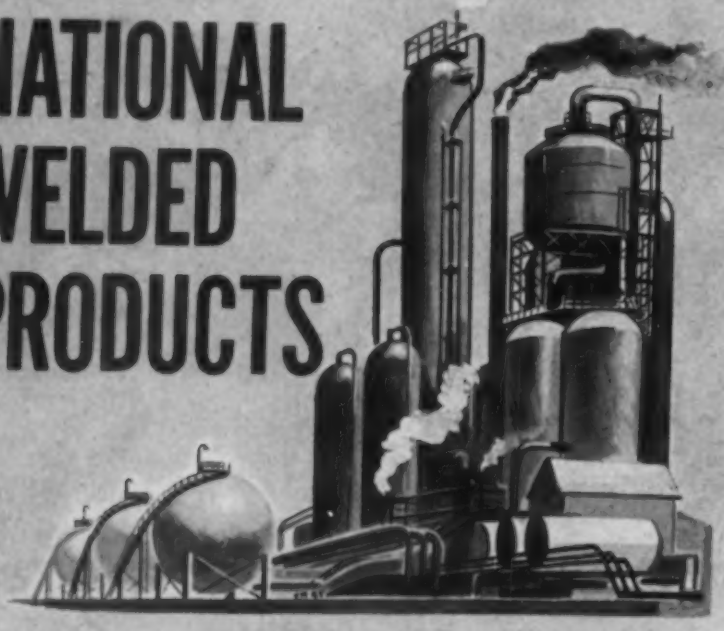
Offices and Plants in Principal Cities
Pacific Coast: Morris P. Kirk & Son, Inc., Los Angeles
Canada: The Canada Metal Company, Ltd., Toronto

NATIONAL WELDED PRODUCTS



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FROM OPEN HEARTH, STAINLESS, ALLOY AND CLAD STEELS

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9'0" x 10'4½" long.
A.S.M.E. Code—U-68.
Plate thickness ¾"

Dependability is the by-word for National Welded Products. It is built into every phase of engineering and production—to assure you of pressure vessels and other fabricated equipment that meets exacting codes and requirements. Let us work with you in solving your difficult fabricating problems.

Pressure Vessel
Section 54" I. D.
x 11'8⅝"
Plate thickness ⅞"

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- Annealing Covers
- Tin Pots
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- Wire Annealing Pots
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National
ANNEALING BOX COMPANY
API-ASME Codes • Stress Relieving • X-ray
Pledged to Quality Since 1895
WASHINGTON, PENNA.

ment: (1) Countercurrent packed towers with and without internal or external acid coolers; (2) "stagnant pool" type of absorbers (Woulff tourills, Cellarins absorbers, Meyer absorbers, etc.); (3) internal cascade pipe sections of fused silica (Tyler "S" bends, Vitreosil absorbers, etc.) These designs were dictated by the lack of materials combining corrosion resistance to HCl with good heat transfer. All employed silica base materials of construction.

The advent, about ten years ago, of Karbate impervious graphite and tantalum construction materials showing complete inertness to hydrochloric acid combined with thermal conductivities superior to steel opened up new approaches to the problem in spite of the relative cost of these materials compared with the silica base products. The thermal conductivity of Karbate and tantalum are 75 and 32 Btu. per (hr.) (sq.ft.) (deg. F.) (ft.) respectively at room temperature.

The trend of hydrogen chloride absorber designs is clearly indicated by comparison of the absorption capacities per square feet which tell that in extreme cases the size of absorber installations to perform a given job has decreased as much as 100 fold from tourills to falling-film absorbers. These new, compact, lightweight absorbers have lower installed costs and much lower maintenance because they are for all practical purposes immune to thermal shock, have a greatly reduced number of connections and have added protection from the steel cooling water jackets.

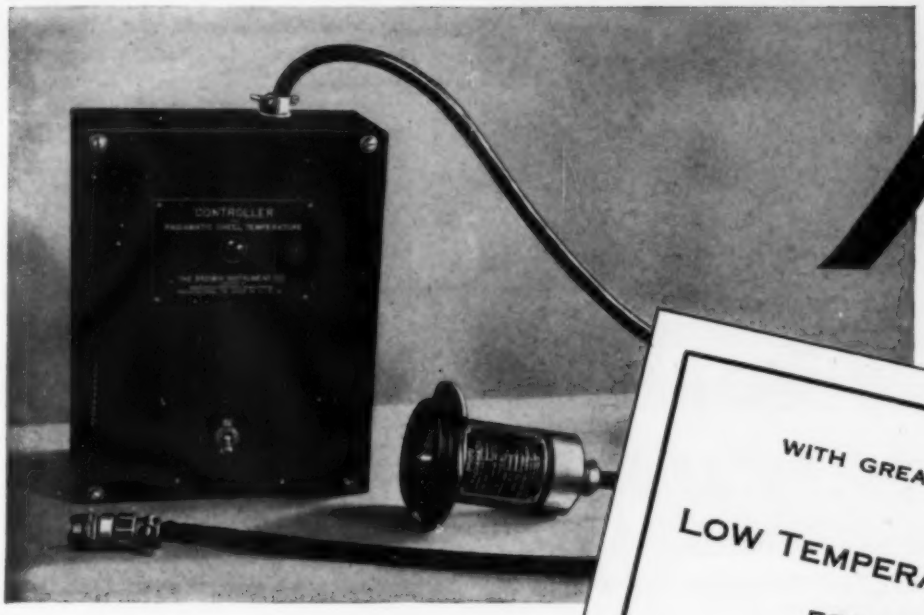
James Coull, C. A. Bishop and W. M. Gaylord, University of Pittsburgh, before American Institute of Chemical Engineers, Cleveland, May 9-12, 1948.

Southern Inertia

More than 85 percent of southern industry is now controlled outside the region. To a large extent this situation can be attributed to the inertia of the South itself. It is not too late to prevent complete colonization, but such action demands a substitution of backbone for wish bone.

Research activity must precede industrial activity. There are 43,000 manufacturing plants without research facilities in the South, which maintains less than 5 percent of the country's research laboratories and spends less than 5 percent of the national research budget.

The birth of new industries is hindered by those concerns which lack faith in research but operate what is termed a research department. The latter is generally responsible to sales or operating personnel. It is unfair



New

WITH GREAT PRIDE WE PRESENT
THE
LOW TEMPERATURE RADIAMATIC
FOR TEMPERATURES
BETWEEN 70 AND 600°F.
AN OUTSTANDING ADVANCE
IN INSTRUMENTATION

The full scope of this new development is unknown. Original installations, however, prove that it opens new horizons in low temperature measurement and control.

Brown pioneers again with the introduction of a practical radiation pyrometer for low temperatures.

The new *Radiamatic* provides a means of controlling low temperature processes where a thermocouple or thermometer bulb cannot be placed in contact with or sufficiently close to the work to obtain reliable readings. It can be used where vibration and shock would damage other temperature measuring means—where work moves or rotates.

Already the new Low Temperature Radiamatic has filled an instrumentation need on plastic mills, rubber mills, plastic finishing rolls, continuous curing ovens and paint pigment kilns. It has also been used in the study of radiating characteristics of surfaces.

PERTINENT POINTS

(1) The instrument is supplied with a 0 to 100 scale. (2) Some customers have successfully used the low temperature *Radiamatic* for temperatures below 70°F., we are now in the process of accumulating such field data for your future benefit. (3) The material being measured must have emissivity which is consistent to within a small percentage of its nominal value. (4) The room temperature surrounding the *Radiamatic* head should always be below 120°F.

WE SOLICIT YOUR INTEREST

Production is limited. However, we solicit your inquiries. This new device may solve an outstanding control problem in your field . . . and solving your control problems is our primary interest.

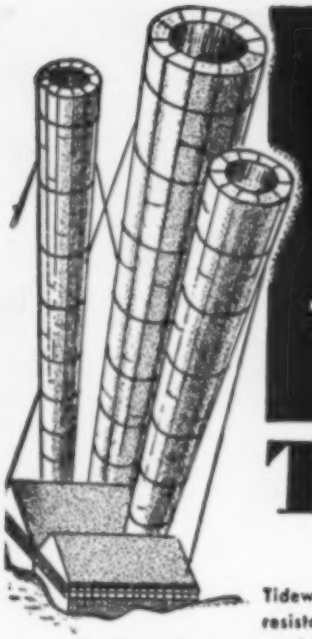
THE BROWN INSTRUMENT COMPANY, 4478 Wayne Ave., Philadelphia 44, Pa.

DIVISION OF MINNEAPOLIS-HONEYWELL REGULATOR CO.

Offices in principal cities of the United States, Canada and throughout the world.

BROWN *Advanced Instrumentation* **FOR BETTER PROCESSING**

Product of MINNEAPOLIS **Honeywell**



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Naturally Resistant
TO ACIDS, ALKALIES AND DECAY

Tidewater
RED CYPRESS

Tidewater Red Cypress serves better and lasts longer. It's natural resistance to acids, alkalies, etc. insures long and satisfactory results when used in vent stacks, pickling troughs, electroplating vats, etc. It's use under these conditions truly confirms its claim to being "The Wood Eternal".

If you have a particularly perplexing problem let us help you solve it. We invite inquiries concerning all types of tanks and vats . . . fully fabricated or partially fabricated.

The Wood Red Cypress "The Wood Eternal"

FLEISHEL LUMBER COMPANY

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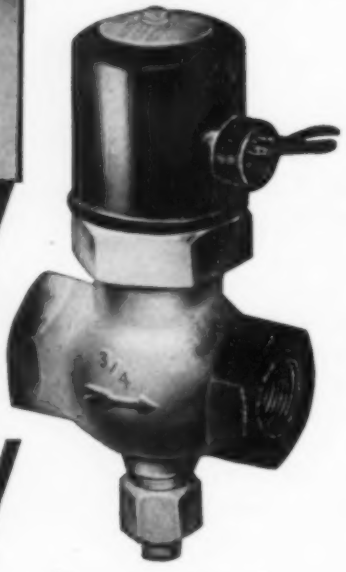
New SINGLE SEATED VALVES



- Unsurpassed refrigeration valves, specifically designed for the control of Freon, Sulphur-dioxide, Methyl-chloride—suction lines or hi-pressure liquid lines. Also air, water, gas, light oil, etc.
- These direct operated, single seated needle valves are held open electrically, thus eliminating unnecessary compressor burdens. Positive shut-off for fractional tonnage installations.
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to admonish this wasted effort when the chemist through fear of losing his job does not advise management properly.

Industrial progress is frequently distorted by percentage instead of absolute figures. For example, the per capita income in the South increased 267 percent and the value of southern manufactured products has increased over 100 percent since 1939. These figures are less impressive when it is learned that the per capita income for New York is $1,633 and $843 in Tennessee, and that the South still accounts for only 20 percent of the nation's manufactured products.

Raymond B. Seymour, Industrial Research Institute, University of Chattanooga, before American Chemical Society and American Institute of Chemical Engineers, Bristol, Va., May 8, 1948.

Improving Maggie's Brightness

BRIGHT metallic finishing of magnesium, long awaited by manufacturers who want a scratch-resistant and durable bright metallic finish for the light metal, is now available for commercial production. Automotive parts, cameras, home appliances, hardware and many other products can now be made in magnesium and electroplated with chromium, nickel or other hard, bright surfaces.

Key to success of the process, which has been under development for several years, is the application of a thin zinc coating to the magnesium part by simple immersion in a pyrophosphate zinc solution. Thereafter, electroplating procedure standard for other metals are used. The process is said to be comparable in cost and skill required to electroplating of zinc and steel. Finishes produced have excellent stability. Feasibility of the process has been shown in actual production runs of such products as drawer pulls and advertising medallions.

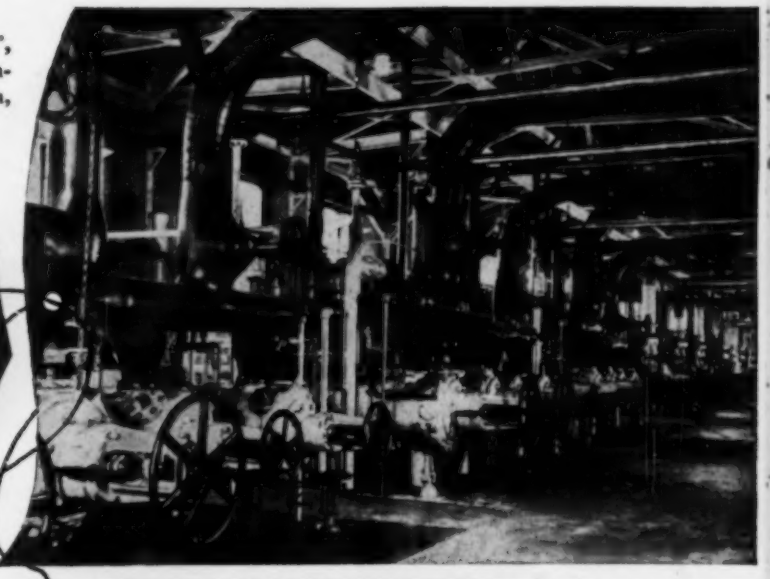
W. S. Loose, Dow Chemical Co., before Magnesium Association, New York, March 18-19, 1948.

New Polymers

COPOLYMERS of styrene and iso butylene produced by low-temperature polymerization techniques are saturated thermoplastic resins whose characteristics include excellent resistance to the penetration of moisture and gases, good electrical properties, and easy processability. They are soluble in aliphatic and aromatic hydrocarbons and waxes. The polymers are readily compatible with several resins and elastomers.

These plastics possess many properties normally associated with both thermoplastic resins and elastomeric materials. Tensile strengths equal

6 Clark 6-cyl., 600 B.H.P., "Right Angle", gas-engine-driven compressors in Commercial Solvents Corp. plant at Sterlington, Louisiana.



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The other 15 Clark Compressors in this plant are of the famous 2-cycle, "Right Angle", gas-engine-driven type, in capacities of 300, 600 and 800 B.H.P. Some are used for cooling and condensing the ammonia after it is made and the rest for pumping gas for miscellaneous services.

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R. G. Newberg, Standard Oil Development Co., and O. C. Slotterbeck, Esso Standard Oil Co., before Division of Paint, Varnish and Plastics Chemistry, American Chemical Society, Chicago, April 21, 1948.

Vapor Phase Separation

The Hypersorption unit at Midland was designed and built to recover ethylene normally lost in the demethanizer column overhead stream from an existing low-temperature fractional distillation unit.

The feed gas, available at the boundary limits at 120 psig. and about −130 deg. F., is depressured to 75 psig., heated to atmospheric temperature by interchange with the overhead product, and introduced to the Hypersorber tower. A small stream of the 120 psig. feed gas is utilized as a gas seal in the lift gas blower labyrinth gland.

The overhead and purge gas streams, consisting essentially of hydrogen and methane, pass through cyclones for dust removal and are eventually combined and sent to fuel. The discharge gas, disengaged below the cooler, has a very low dewpoint since the activated carbon in the adsorption section is an excellent desiccant. In this operation it is cooled to −100 deg. F. in the feed interchanger without any difficulty with ice formation. The bottom product gas, containing about 92+ percent ethylene after condensation of the stripping steam, is dehydrated in alumina dryers and combined with the ethylene product from the low-temperature fractionation plant.

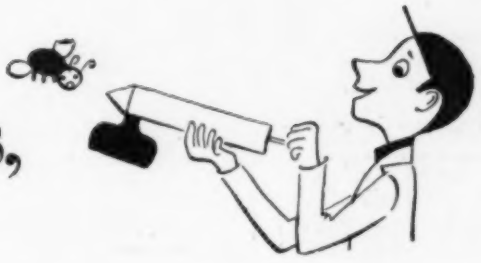
This unit was designed to process 1.8 mcf. of feed gas per day at a pressure of 75 psig. The maximum carbon rate is about 32,000 lb. per hr. at a carbon stripping temperature of 500 deg. F.

The Hypersorber tower for this installation is 4.5 ft. in diameter and approximately 85 ft. high. A vertical bin 4.0 ft. in diameter and 60 ft. high provides for storage of the Hypersorber charge during inspections and for carbon make-up during operation.

Auxiliary equipment include a Dowtherm furnace, product-gas cyclones,

If you make cleansers

or insecticides,



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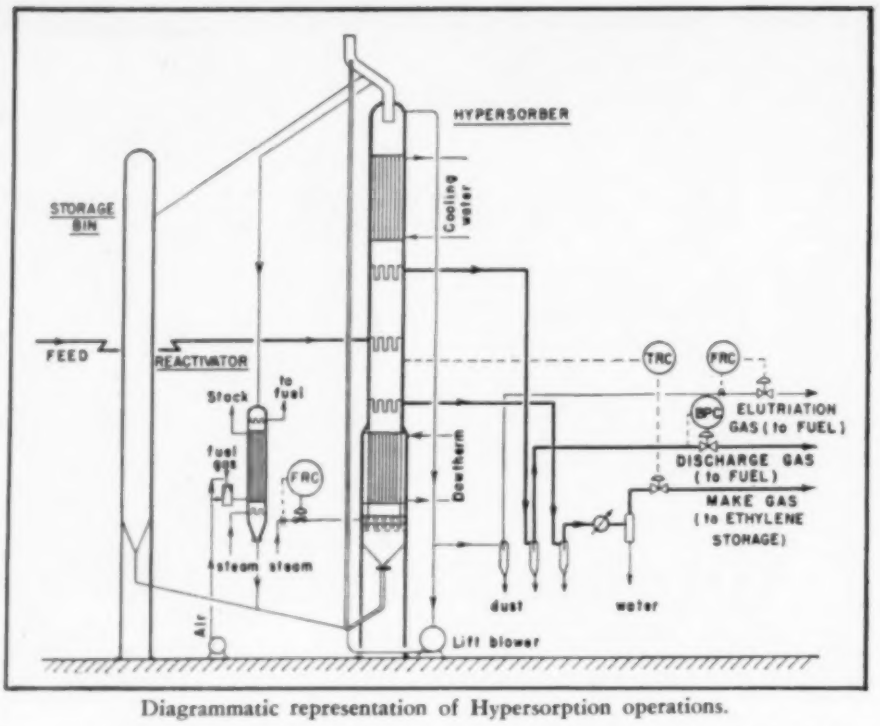

Diagrammatic representation of Hypersorption operations.

a condenser and knockout drum for the bottoms product, and a lift gas circulation blower.

Pilot plant data indicated the ethylene concentration in the bottoms product (make gas) would be about 91 percent, with an over-all recovery of 96 percent and a methane contamination of 1.1 percent. Actually the make gas has shown an average ethylene content of 92-93 percent, an over-all recovery of 98 percent, and a maximum methane contamination of 0.1 percent. On a carbon

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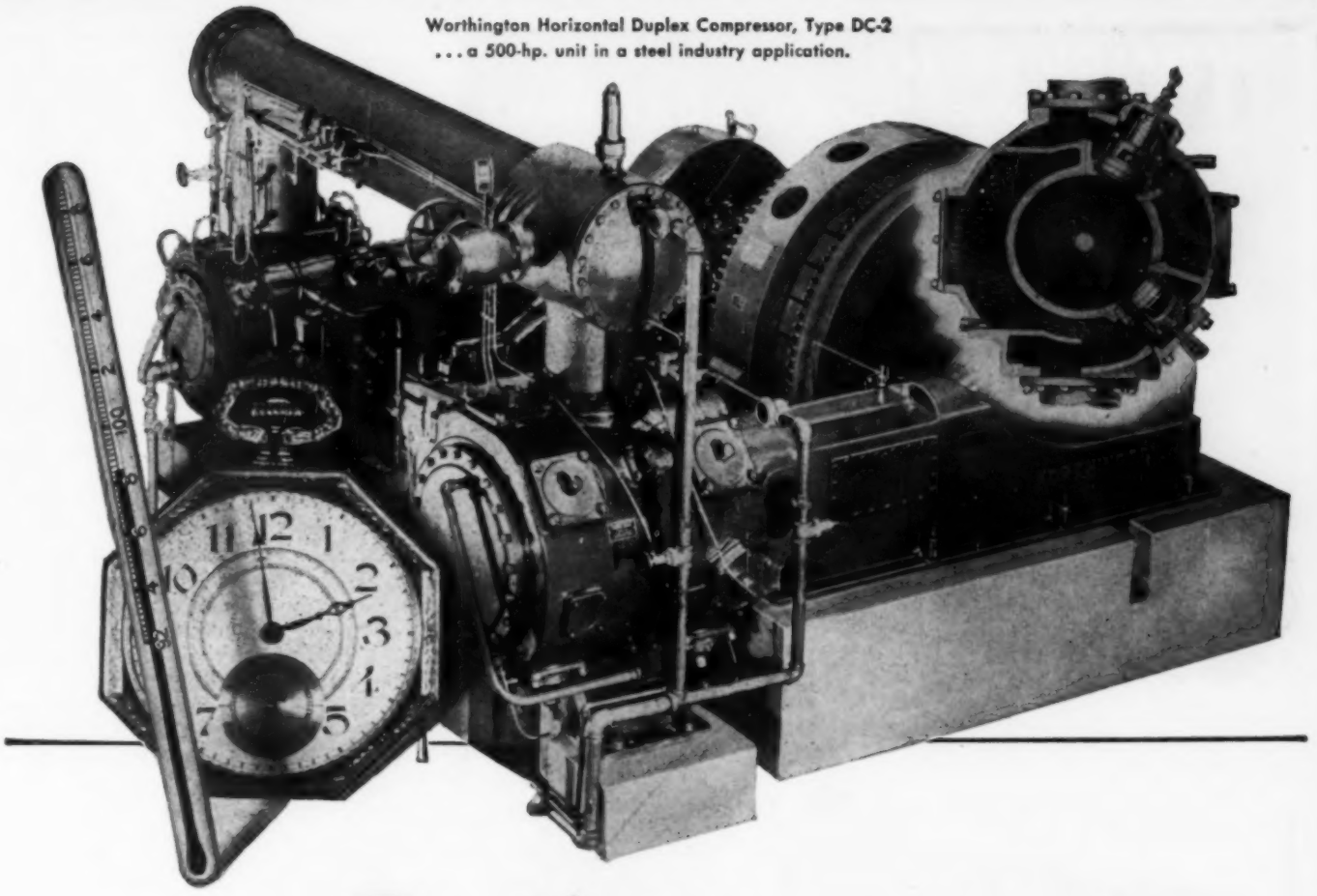

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*REG. U. S. PAT OFF. K7-6

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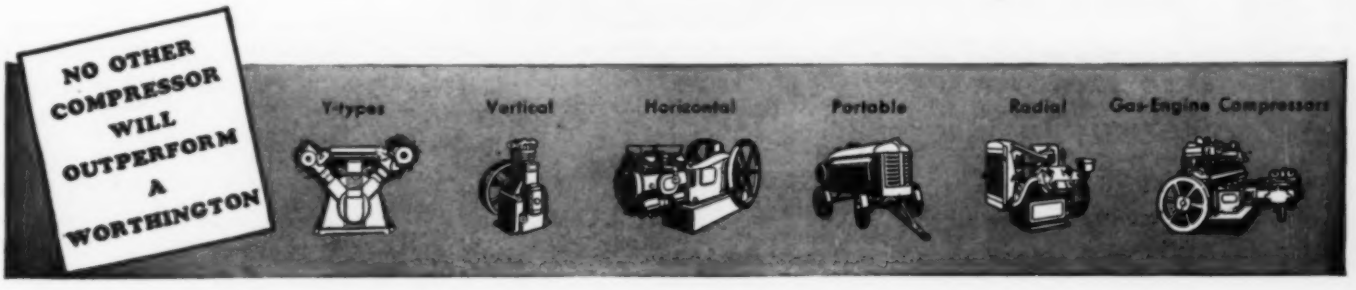

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dioxide free basis, this stream contains 95.2 percent ethylene. The maximum ethylene content of the overhead product has been 0.1 percent.

The control of the column operation to maintain the desired separation is based on the abrupt temperature break occurring in the rectifying section due to adsorption of the reflux of substantially pure ethylene from the stripping section below.

The activated carbon used in this unit had a nominal mesh range of 12-30 (Tyler screen series) when charged. The initial charge to the unit was about 15,000 lb. having an average bulk density of about 29 lb. per cu. ft. As the carbon is circulated, the corners of the particles become rounded and the proportion of particles in the smaller mesh sizes increases, both factors tending to increase the bulk density. In this plant the bulk density of the charge has leveled off at 35 lb. per cu. ft.

The application of Hypersorption Process to commercial size equipment has involved the development of a number of specialized mechanical designs. Of primary importance is the carbon flow control mechanism, which assures both positive volumetric rate of carbon flow and equal distribution of the flow throughout the cross sectional area of the column. The mechanism consists of a moving tray with a number of elliptical shaped downcomer tubes so aligned with corresponding tubes and slots in stationary trays above and below that half the downcomers are filling and half discharging at each end of the reciprocating stroke.

Although Hypersorption is particularly well adapted for this type of ethylene recovery service, it comprises a fundamental vapor phase separation process that is adaptable to widely varied commercial applications. Because of its low capital investment and operating costs and its high yields and product purities, it presents the optimum method of separation of many gaseous mixtures.

Howard Kehde, R. G. Fairfield, J. C. Frank and L. W. Zahnstecher before American Institute of Chemical Engineers, Cleveland, May 9-12, 1948.

Curricular Rearrangement

CRITICAL review of the undergraduate program in chemistry reveals the urgency of a major revision to alleviate the mounting dissatisfaction with the course in general chemistry and to provide space in the curriculum for advanced courses dealing with newer topics. The position of secondary school chemistry relative to college chemistry, the increasing importance

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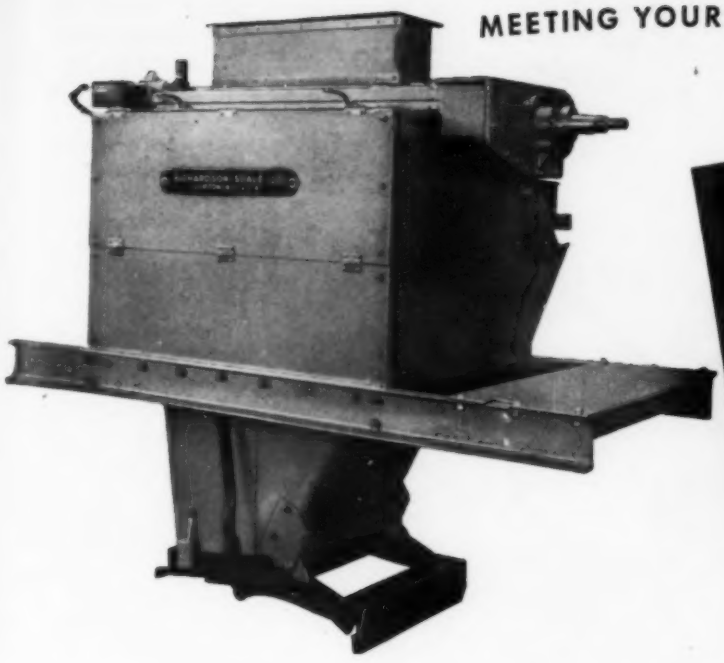

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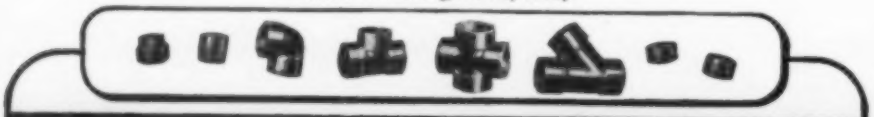

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of inorganic chemistry, and a new emphasis on analytical chemistry must be considered in this revision. From this appraisal, the pedagogical sequence of inorganic, analytical, organic, and physical chemistry appears to be the result of historical accident, rather than of logical planning. The repetition of various diluted versions of physical chemistry in the courses in inorganic chemistry, qualitative and quantitative analysis is extravagant of time.

A program is proposed for majors in chemistry in which the fundamentals of organic, physical, and inorganic chemistry (mainly in that order) will be studied during the freshman and sophomore years. Advanced work in analytical, inorganic, organic, physical, and biological chemistry may be elected in the last two years. Physical chemistry will be made a practical tool for analytical chemistry and will be a prerequisite for the rigorous inorganic course.

James S. Coles, L. B. Clapp and R. P. Epple, Brown University, before Division of Chemical Education, American Chemical Society, Chicago, April 19, 1948.

What's Patentable

Our patent system is based upon a constitutional provision which has as its paramount purpose the promotion of the useful arts and sciences. The manner in which courts are adjudicating patents clearly indicates that private interests are of secondary consideration.

Congress pursuant to the constitutional mandate enacted legislation to define the conditions under which patents may be granted. Strict compliance is absolutely essential for adequate patent protection. The patent statutes require that the invention fall within the categories of arts, machines, manufacturers, compositions of matter, asexually reproducible plants, and designs for articles of manufacture. Abstract discoveries such as general scientific laws or principles cannot be patented. Neither the cause nor its effect is patentable as such, but the means by which the cause is applied to produce the effect may be patentable.

Subject matter to be patentable must be sufficiently useful and important to justify the grant of a patent. It must not only have a good and useful purpose, but it must also be capable of accomplishing its intended purpose. The patent statutes require that the subject matter to be patentable must have novelty. Novelty may be disproved by means of prior patented or unpatented inventions, prior printed publications, or evidence of prior knowledge or use.

Subject matter of a patent must

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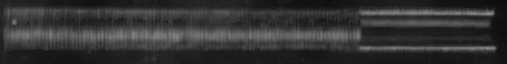

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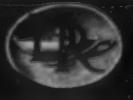

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have been created by the exercise of inventive ingenuity, and must involve invention over what preceded it.

Question of invention is the most difficult in the entire field of patent law. It is impossible to set up tests to fit all cases. However, it may be stated as a general rule that no matter how simple or obvious an invention may appear to be after it is made, it is nevertheless patentable if it has produced a disproportionate or unobvious change in result or solved a difficult or previously unsolved problem.

Courts generally reason by analogy. Reasoning by analogy is very restricted in chemistry and biology. Hence, it is not safe to assume that an untried chemical will have the same effect as others unless there is close structural similarity. The fact that a new chemical is structurally related to an old compound does not preclude patentability if new compound has unobvious or unpredictable characteristics. An old type of process used for making a new chemical compound is not patentable, unless there was reason to believe that process could not be adapted for making the new compound. Patentability of new compound made by old type process depends upon merits of the compound itself.

Charles W. Rivise and A. D. Caesar, before Division of Chemical Education, American Chemical Society, Chicago, April 19, 1948.

Statistical Criticism

RELATIONSHIP between the scientific method and statistical techniques is shown by classifying the functions of the scientific method and those available by statistical procedures. The scientific method is broken down as follows: (1) The creation of a hypothesis. (2) The design and execution of an expirement to test the hypothesis. (3) The test of the truth of the hypothesis by the results of the experiment.

The role of statistical procedures can be listed: (1) Principles of the design of experiments and of the collection of data. (2) Methods for reducing data to show relationships and to calculate the best estimates of parameters. (3) Methods for calculating the reliability of experimental results and tests of truth of hypotheses on the basis of "statistical significance."

Statistical procedures are recommended as quantitative and efficient for performing the second and third steps in the scientific method.

The traditional method of "holding everything constant and changing only one factor at a time" is inefficient and incapable of showing the effects of

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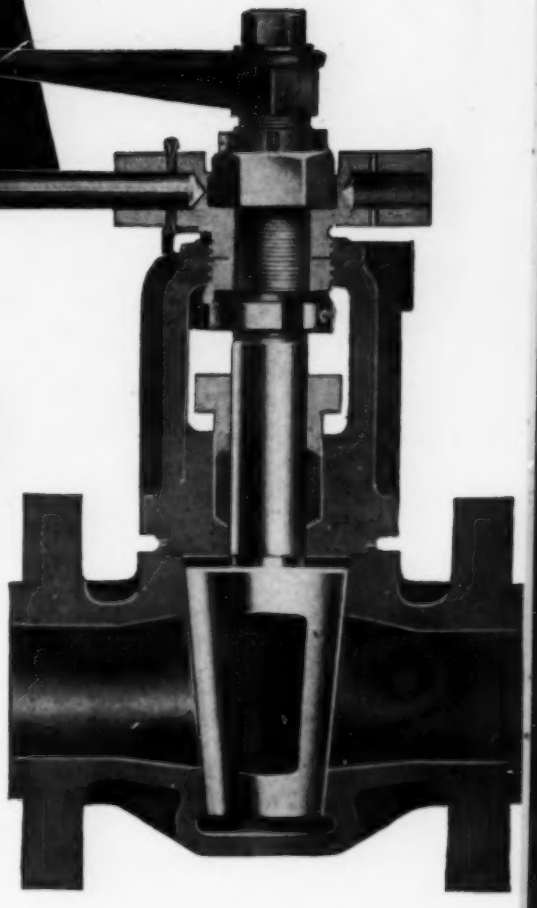
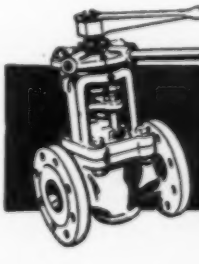


Built into each valve is a powerful lever-and-screw device that prevents sticking and assures positive action at all times and under all conditions. Corrosive or viscous fluids, extremes of temperature or pressure or other adverse operating conditions that cause ordinary valves to fail cannot affect Homestead Lever-Seald Valves.

Operation is simple and easy. Seating pressure is first relieved with the lower lever just enough to overcome friction. Then a quarter-turn of the upper lever fully opens or closes the valve. Full seating pressure is again applied with the lower lever to make a positive, leakless seal. They operate faster, too . . . 16 to 28 times faster than screw-stem-type valves. The quarter-turn principle makes them ideal for installation in restricted areas, next to walls, floors, ceilings, congested piping and other obstructions where many other types of valves could not be operated.

Homestead Lever-Seald Valves are available in combinations of metals and alloys to meet your service requirements. Sizes range from 1¼" to 10" for pressures from vacuum to 1500 pounds.

For complete details write for Valve Reference Book No. 38 . . . today.

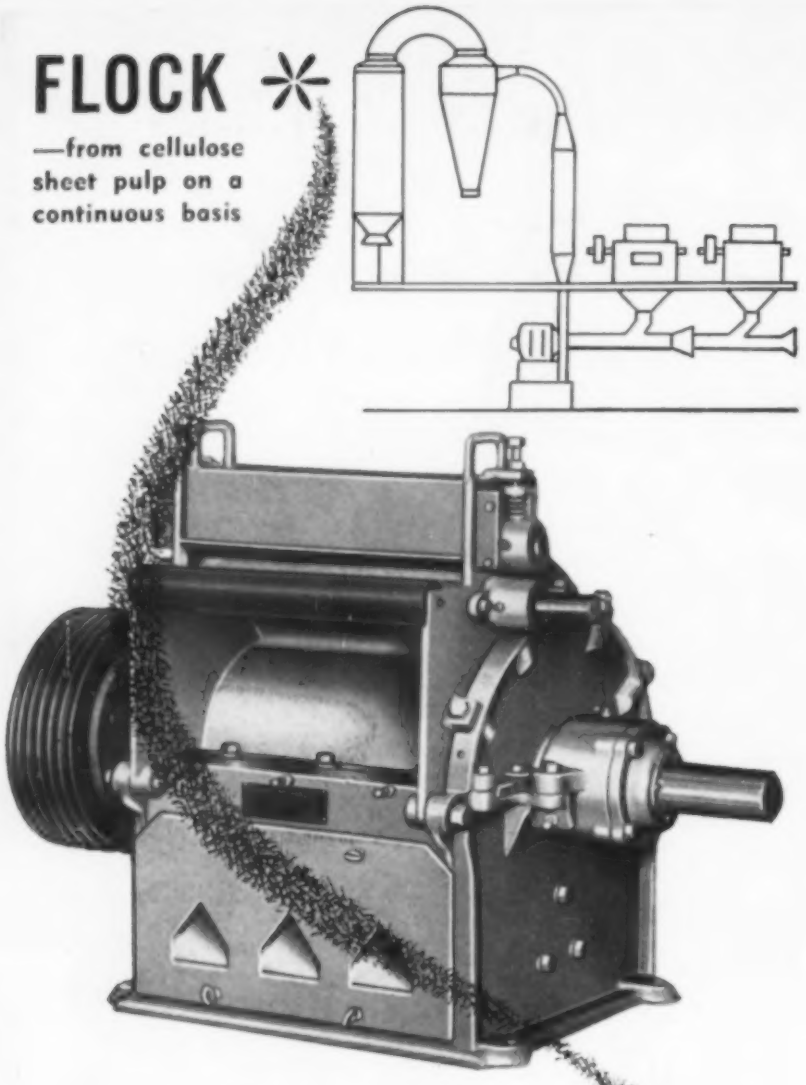


HOMESTEAD *LEVER-SEALD VALVES*

HOMESTEAD VALVE MANUFACTURING CO. · P. O. BOX 13 CORAOPOLIS, PENNA.

FLOCK *

—from cellulose sheet pulp on a continuous basis



That's the job this Sprout-Waldron Flocking Cutter with built-in compression feed rolls is equipped to do.

Similar S-W Equipment is successfully producing FLOCK from nylon, felt, leather, hair and fur. Whether your Flocking needs demand a single unit or a complete system, you can depend upon Sprout-Waldron for an experienced recommendation.

This is just another example of ADAPTIONEERING AT WORK—providing improved operating techniques through better equipment—engineered for a specific job.

FLOCK *

Fiber stock cut to very short segments as required for plastic reinforcing filler, etc.

If you reduce, mix, separate, or handle material in bulk, consult Sprout, Waldron & Co., Muncy, Pa.

SPROUT WALDRON
Manufacturing Engineers

interactions between two or more factors. Current experimental work in the chemical field is wasteful and inefficient in view of available techniques for the design of experiments and the analysis of experimental data.

W. L. Gore, E. I. du Pont de Nemours & Co., before Division of Paint, Varnish and Plastics Chemistry, American Chemical Society, Chicago, April 21, 1948.

Tall-Oil Soaps

A STUDY has been made of the detergency and foaming power of soaps made form a typical American tall oil, acid-refined. Sodium soaps of tall oil with and without the unsaponifiable fraction, straight tall-oil fatty-acid soap, and straight tall-oil resin-acid soap were evaluated. The effect of fatty acid-resin acid ratio was determined on mixtures of those soaps. As comparison standards, sodium rosinate, sodium oleate, and mixtures of those soaps were used.

Tall oil has a greater detergency value than sodium rosinate. Tall-oil fatty-acid soap is slightly poorer than sodium oleate as a detergent. This is ascribed to the higher unsaturation of the tall-oil fatty-acid soap. This appears to be approximately equivalent to soap from various common unsaturated vegetable oils. Wash tests on cotton show both resin-acid and rosin soaps to be poor.

As a rough approximation, tall-oil soap without unsaponifiables is equivalent to a corresponding mixture of sodium oleate and sodium rosinate. The presence of unsapifiables lowers detergency and foaming somewhat, though even then the soap is decidedly superior to rosin soap.

Tall-oil soaps show surface tensions much lower than rosinates, somewhat higher than oleates.

Important differences between detergencies of soaps and especially between soap mixtures, are obscured when launderometer tests are run at moderate soap concentrations. These differences are readily detected at lower concentrates. Greater proportions of tall-oil soaps than of rosinates can be used to extend fatty soaps without significant loss in detergency.

Foster Dee Snell and Irving Reich, Foster D. Snell, Inc., and J. B. Calkin, Union Bag and Paper Corp., before Division of Colloid Chemitry, American Chemical Society, Chicago, April 19, 1948.

Ion Exchangers

PRACTICAL water treatment generally is directed toward purifying the water to the degree that the use requires and seldom toward complete purification or total removal of all impurities. Consumers are accustomed to securing large amounts of water at the lowest cost. They are interested

Good-rite
CHEMICALS

Ethers of Hydroquinone

Monobenzyl Ether of Hydroquinone

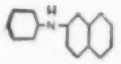
Dibenzyl Ether of Hydroquinone

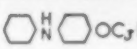
Monobenzyl ether of hydroquinone may be used as an antioxidant, stabilizer, or plasticizer in pharmaceuticals, paints, varnishes, and organic synthesis.

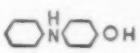
Dibenzyl ether of hydroquinone may be used as a high boiling solvent for perfumes, cosmetics, pharmaceuticals, plasticizers, paints, varnishes, and organic synthesis.

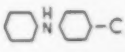
Other organic chemicals

Secondary Aromatic Amines

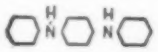

Phenyl B-Naphthylamine

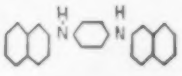

p-Isopropoxy Diphenylamine


p-Hydroxy Diphenylamine

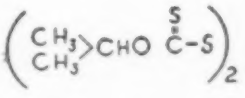

Mixed Mono and Diheptyl Diphenylamines

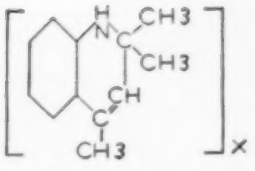
Di-secondary Aromatic Amines

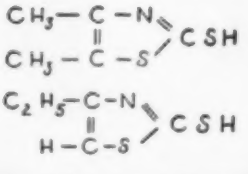

Diphenyl p-Phenylenediamine

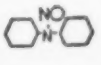

Di B-Naphthyl p-Phenylenediamine

Miscellaneous


Di-Isopropyl Dixanthogen


Trimethyl Dihydro Quinoline Polymer


Mixed Ethyl and Dimethyl Mercaptothiazoles


N-Nitroso Diphenylamine

All materials listed here are available in commercial quantities. Prices and technical information are available on request. Please write Dept. CD-6, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio.

B. F. Goodrich Chemical Company

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GEON polyvinyl materials • HYCAR American rubber • KRISTON thermosetting resins • GOOD-RITE chemicals

When it comes to
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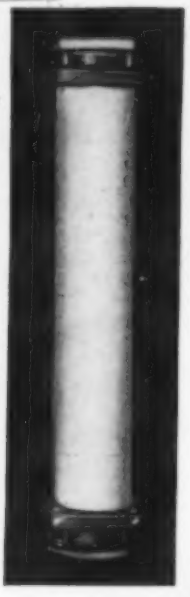
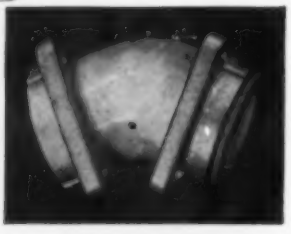
CHEMICALS

SPECIFY ILLINOIS PORCELAIN!

Porcelain's inherent corrosive-resistant qualities make it impervious to electrolytic action. Therefore it is outstanding as a successful handling medium for chemicals. Specify Illinois porcelain for permanent systems, thereby eliminating frequent replacements of corroded parts.

ANGLE VALVES
Available in all standard sizes from 1" to 6", these valves are designed for easy installation. Wherever an elbow can be removed, a valve can be installed because of exact dimensions.

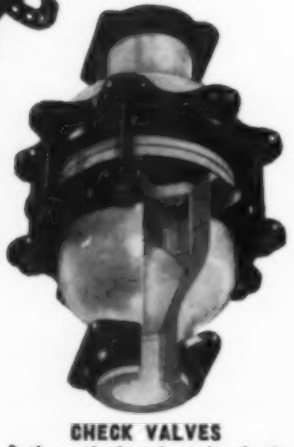




PIPE AND FITTINGS
The inside and outside of all porcelain pipe and fittings are glazed white. The ends are ground true and smooth for gasket mounting. Flanges are accurately jig-assembled. Necessary bolts and nuts to make all connections are furnished for every joint.

WRITE
FOR
CATALOG C-2

Y-VALVES
Each Illinois valve has a very carefully ground and lapped valve seat which will hold chemicals at high pressures. Every valve is routine tested at 100 pounds pressure for a minimum of one hour to assure a perfect valve seat. Note that valve seat is located in lowest possible position to insure uninterrupted flow of material when stem is in open position. Packing is acid-resisting asbestos — graphite impregnated.



CHECK VALVES
Both vertical and angle check valves are porcelain to porcelain with no metal in contact with material being handled. Friction loss extremely low because ample space provided for flow around ball. Valve seat ground and polished to very close tolerances — ball is a polished sphere.

CHEMICAL
ILLINOIS
ELECTRIC PORCELAIN CO.
MACOMB, ILLINOIS

in paying for water treatment to the extent that the product is sufficiently good but are not interested in a slightly better water at an appreciably increased price. By means of ion exchangers, it is possible to remove dissolved mineral matter in part or in entirety or to qualify the characteristice of any water. Thus ion exchangers apply to water treatment not only in the process of complete removal of impurities but also in the much larger fields of partial purification.

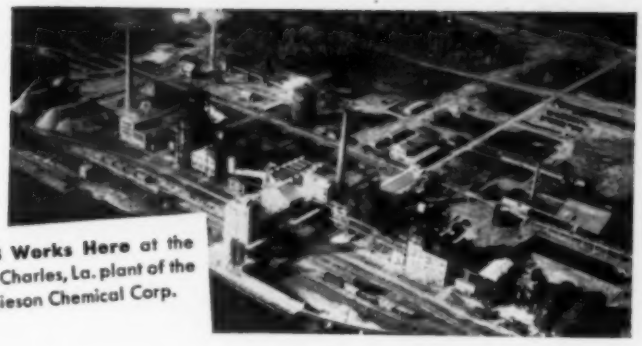
Ion exchangers are convenient and versatile tools of considerable usefulness in the art of water treatment. In one application, ion exchangers may compete against precipitation methods of treatment, in another against distillation, in a third against an alternative ion exchange procedure, and in a fourth may complement another method or methods of treatment. Occasionally, ion exchangers are used as filters to remove suspended matter, but such an application is not generally sound or practicable. Ion exchangers have been given an increased amount of attention in the past few years. This expanded interest seems due largely to the discovery of synthetic organic exchangers which apparently captured the imagination of resin manufacturers as it opened a new field for resin application. It appears worth while to consider the more important applications with due consideration to the importance or extent of the individual application, the costs, and the comparisons with alternative methods of treatment.

H. B. Gustafson, Infilco, Inc., before Division of Water, Sewage and Sanitation Chemistry, American Chemical Society, Chicago, April 21, 1948.

Obstacles on the Road To Knowledge

It is of vital importance to the well-being of the United States to maintain the supply of well-trained and capable chemists and chemical engineers. The process of education begins in the grade and high school and continues through the university days and working days of the individual.

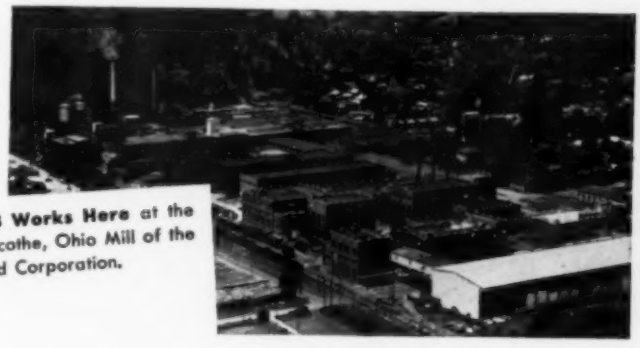
While many schools and departments are doing a good job, there are many handicaps in the path of the science training program—inadequate and poorly trained staff, particularly in elementary courses, difficulties in providing stimulating personal contact with real teachers, overcrowded laboratories and insufficient equipment, inadequate counseling service and screening procedures, lack of awareness of new teaching aids and devices, teachers with narrow back-



4+8 Works Here at the Lake Charles, La. plant of the Mathieson Chemical Corp.

4+8 Works Here at the Kodak Park plant of Eastman Kodak Co., Rochester, N.Y.

alkali OR FILMS



4+8 Works Here at the Chillicothe, Ohio Mill of the Mead Corporation.

4+8 Works Here at the Midland, Michigan plant of The Dow Chemical Company.

paper OR CHEMICALS

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With four basic circuits and eight basic component parts you can get more than 100,000 different electronic instrument and control combinations. Your problems of measuring and controlling flow, level, speed, pressure temperature, gas analysis, pH, conductivity, etc., can be solved by the right combinations of these 4 circuits and 8 basic parts.

You don't have to load up a stock room with parts. Bailey parts are interchangeable. What you used for the last combination is good for the next one when conditions in your plant change. You can save money, as others are doing, when you standardize on Bailey controls.

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grounds and limited horizons teaching mature men and women who have broad interests and wide horizons, lack of correlation among instructors and between courses, competition by industry and government for relatively poorly paid instructors and capable seniors who should be going to graduate schools, slogans by industry "We can give you a better graduate training than can the graduate schools," promotion of good teachers by educational institutions to deans and department heads, making scientific contact with these men even more difficult.

On the other side, there are the desire to learn and willingness to work on the part of the student that make up part of the handicaps, new buildings are coming, temporary laboratories have been built, and there is some indication of a movement back from industry to teaching by the men who went from teaching to industry during the war.

Harry F. Lewis, Institute of Paper Chemistry, before Division of Paper Chemistry, American Chemical Society, Chicago, April 20, 1948.

Neophyte Training

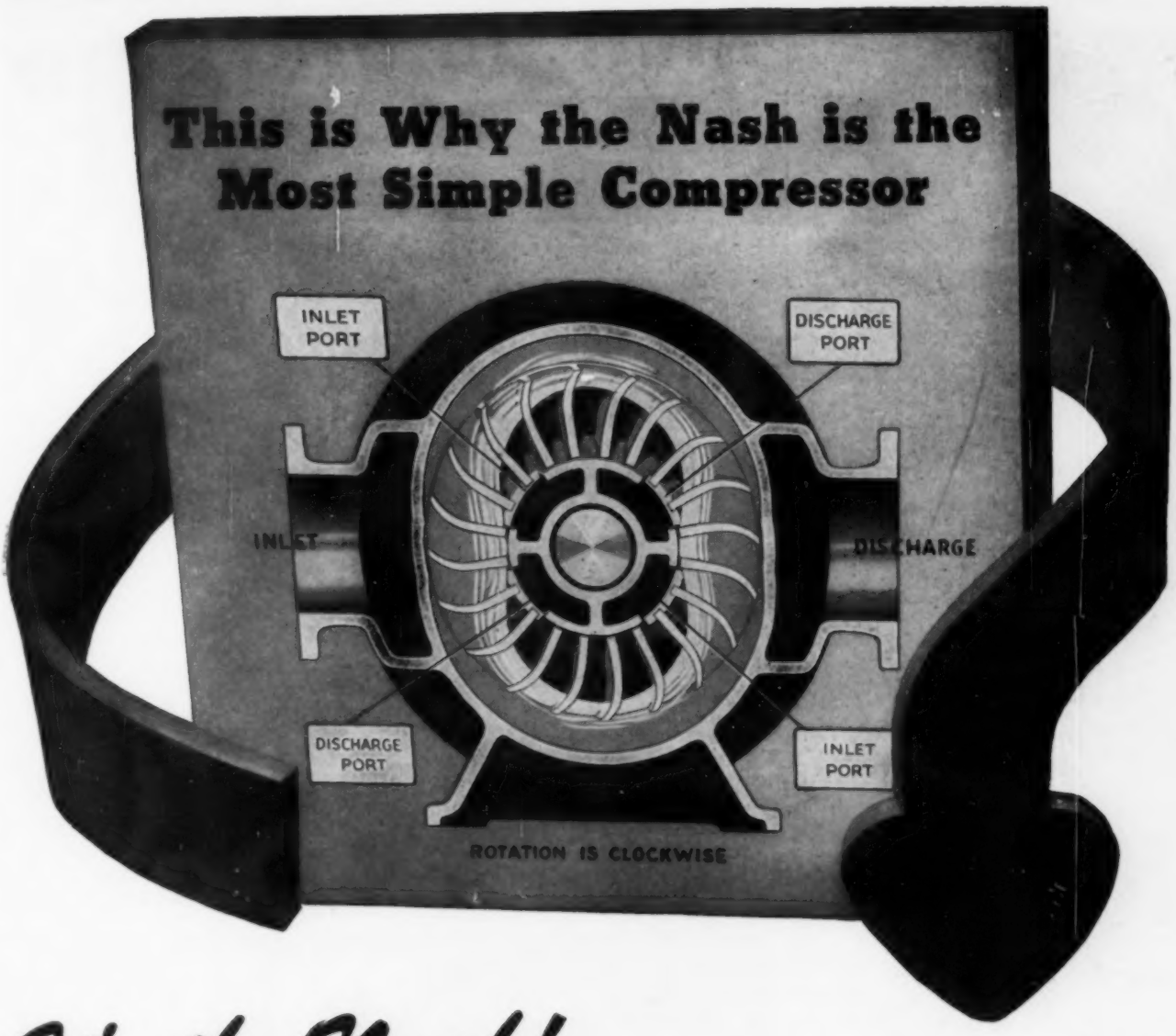
CHEMISTS and chemical engineers are customarily hired directly for specific positions in industry. Most college students at graduation, however, know little of the chemical industry and the job opportunities it offers. A period of industrial training after graduation and before placement in a particular job gives young technical employees actual working experience through which they may learn at first hand the workings of industry and may find by personal contact and participation the type of work best suited to them.

Industrial training should give broad experience in the application of the theoretical principles studied in the universities to the practical problems of industry. Diversity of experience may be given by assigning employees in training for short periods to different research, development, production, and staff divisions. This practical training on the job should be supplemented by formal classroom study to give an orientation in industry and to provide an opportunity for further education in basic technical theory.

Actual experience with training of this nature over the past two years indicates that well-organized industrial training programs are highly effective means for the proper placement of chemical and engineering personnel.

C. H. Kline, Jr. General Electric Co., before Division of Chemical Education, American Chemical Society, Chicago, April 20, 1948.

This is Why the Nash is the Most Simple Compressor



It's the Nash!

There are no mechanical complications in a Nash Compressor. A single moving element, a round rotor, with shrouded blades, forming a series of buckets, revolves freely in an elliptical casing containing any low viscosity liquid. This liquid, carried with the rotor, follows the elliptical contour of the casing.

The moving liquid therefore recedes from the rotor buckets at the wide part of the ellipse, permitting the buckets to fill with gas from the stationary Inlet Ports. As the casing narrows, the liquid is forced back into the rotor buckets, compressing the gas, and delivering it through the fixed Outlet Ports.

Nash Compressors produce 75 lbs. pressure in a single stage, with capacities to 6 million cu. ft. per day in a single structure. Since compression is secured by an entirely different principle, gas pumping problems difficult with ordinary pumps are often handled easily in a Nash.

Nash simplicity means low maintenance cost, with original pump performance constant over long periods. Data on these pumps sent immediately on request.

No internal wearing parts.

No valves, pistons, or vanes.

No internal lubrication.

Low maintenance cost.

Saves floor space.

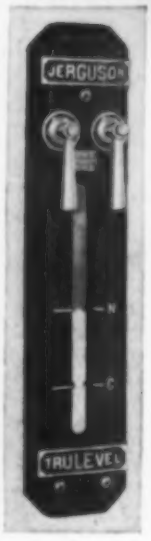
Desired delivery temperature automatically maintained.

Slugs of liquid entering pump will do no harm.

75 pounds in a single stage.

NASH ENGINEERING COMPANY
313 WILSON, SO. NORWALK, CONN.

Here's A Better Way To Read Water Levels Of Inaccessible Boiler Drums!



Use New

JERGUSON TRULEVEL GAGES

For All Distant Reading Problems

JERGUSON TRULEVEL Gages are the ideal solution to your problem when you need to read boiler water level accurately at a distant point, as in the case of inaccessible waste heat boilers.

TRULEVEL brings the liquid level reading of water, or of any condensing medium which you may be using, right down where you can see it. Complete accuracy of reading is assured by the use of a new type datum column, located at the drum.

Quick checking at the distant reading point is another important feature of TRULEVEL, and this is patented and exclusive with Jerguson. By simply turning the two valve handles on the cover it is possible to check gage accuracy *in a matter of seconds*. For accuracy and safety use the Jerguson TRULEVEL.

IMPORTANT! Manometric fluid used in TRULEVEL Gage is color fast! Simple to maintain. No leakage. Another important feature of Jerguson TRULEVEL Gages.

Write for Jerguson Trulevel Data Unit No. 38, without obligation, today!

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FOREIGN LITERATURE ABSTRACTS

Metallic Minerals of Brazil

BRAZIL'S rich and varied resources of metallic minerals really began to be exploited in 1940, due to the demand created by the war. By 1946, however, the total annual exportation of metallic minerals fell down to 229,983 tons, which is less than half of the 1945 figure, 563,094 tons. The attached table shows Brazil's exportation of such minerals in tons, during the period from 1938 through 1946. Although export has fallen off so much, numerous important enterprises have been started in the country which will consume large quantities of minerals of iron, manganese, nickel, chromium, tungsten, aluminum and others. Among the outstanding enterprises is Volta Redonda and the aluminum plant of Ouro Preto.

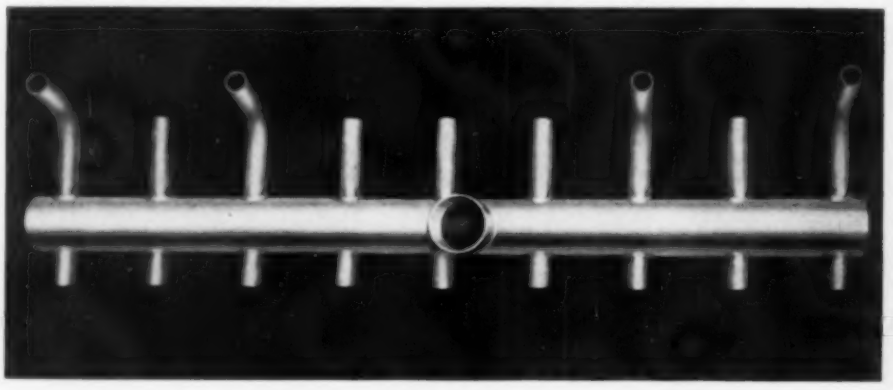
Digest from "Metallic Minerals, Data on the Mining Industry and Brazilian Exportation during the Period of 1938-46", *Boletim do Conselho Federal de Comercio Exterior X*, No. 5, 11-14, 1947. (Published in Brazil.)

Activated Alumina Adsorbent

ACTIVATED alumina is sometimes looked upon as a solid adsorbent of inferior quality. This opinion should be reconsidered, not only because of the efficiency of the product but also

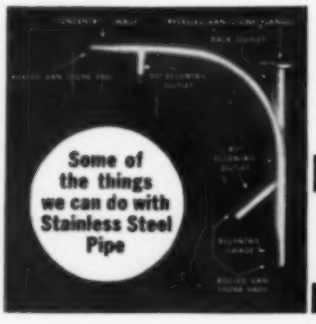
Metallic Minerals Exported From Brazil, Tons

Products	1940	1941	1942	1943	1944	1945	1946
Bauxite	82	14,365	12,397	76,761	2,979	7,060	1,161
Chromium mineral	4,572	4,424	5,776	7,813	4,721	1,490	.....
Lead mineral	296	.....	.....	.....	.....	.....	.....
Copper mineral	.....	.....	.....	.....	.....	.....	173
Hematite	.....	.....	7,112	13,919	122,903	127,651	48,157
Magnetite and iron oxides	5	40	.....	5	.....	.....	.....
Iron mineral	255,548	420,756	308,921	308,878	82,895	172,343	16,256
Manganese mineral	222,713	437,402	306,241	275,552	146,983	244,649	149,149
Ilmenite and iron sand, titanic	12	4,471	.....	.....	2,500	5,000	.....
Nickel mineral	.....	.....	24	502	.....	.....	.....
Rutile	499	2,369	4,615	4,556	1,564	160	88
Monazite sands	180	854	1,430	1,550	3	1,030	1,250
Columbite	15	4	1	.....	.....	.....	7
Zirconium	1,521	4,735	17,114	4,921	2,152	758	4,453
Tantalite	27	91	113	181	201	30	44
Tungsten mineral	10	32	.....	1,167	1,989	2,039	1,476
Beryl	1,472	1,702	1,634	2,027	1,185	510	1,294



Stainless Pipe Pre-fabricated by Pioneer Specialists

Fifteen years ago, we pioneered in developing methods for welding and shop pre-fabrication of stainless steel piping. Today, we use the latest "inert-gas-shielded-arc" welding, which has only recently become commercially available. Photo above shows one of fifty headers recently completed, all alike and each to very exacting tolerances. Curved sections were heat treated to very rigid specifications, after bending, then pickled, passivated and re-checked. Insides of welded joints were made absolutely smooth. No job is too large or too small for our facilities and none too difficult for our engineering experience. . . . Most utilities and large industrial plants know the perfection of our patented Westport Welded Joint and our high pressure, high temperature pipe engineering and pre-fabrication, for we have been in this business for 49 years. Write us, or send your prints for an estimate.



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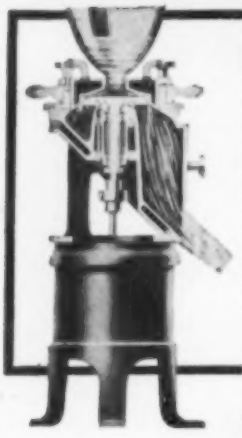

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because of the relative ease of its preparation. The authors prepared activated alumina by careful dehydration of the trihydrate, $Al_2O_3.3H_2O$, and made a study of the adsorbent properties of activated alumina in relation to water vapor and chlorinated organic solvents as well as different organic or mineral substances in aqueous solution: Congo red, arsenious anhydride, iodine. Adsorption of water vapor was of two types: (1) static adsorption, in which humid gas contained in a closed space is dried by placing activated alumina therein; (2) dynamic adsorption, in which a current of humid gas is dried by making it pass through a column of activated alumina. Either method of adsorption is a purely physical phenomenon. The adsorbent properties of the activated alumina which has been saturated with water vapor can be restored by heating it to only 150 deg. C., a much lower temperature than that required for the initial activation of the hydrate. The following table shows the volume of chlorinated solvents retained by activated alumina as compared with silica gel (cc. retained per 100 g. of solvent):

	Activated Alumina	Silica Gel
Tetrachlorethane ...	27.7	37.1
Trichlorethylene ...	26.8	36.8
Dichlorethylene	27.8	38.2

Digest from "Activated Alumina: Its Preparation, Properties and Nature" by H. Thibon, A. Maillard and L. Savon, *Chimie et Industrie* 57, No. 2, 117-125, 1947. (Published in France.)

Magnesium Metallurgy

F. Rochna's long and detailed study of magnesium includes a complete description of this metal's properties and a list of its minerals. The various methods of manufacturing metallic magnesium by precipitation or reduction are given in outline form and then described in detail. These include electrolysis of magnesium chloride, electrolysis of magnesium oxide, and thermoreduction of magnesium oxide. The survey also covers refining of the crude metal, its alloys, casting, application, world production, price, cost of production and future trends. There are two magnesium deposits in the province of San Juan, Argentina. One consists of epsomite and is located in the region of Calingasta-Iglesias. Its annual production is from 1,000 to 3,000 tons with an $MgSO_4$ assay of up to 8 percent. The other is a very large deposit of dolomite, located in Zonda and not exploited at present.

Digest from "Magnesium Metallurgy" by F. Rochna, *Industria Minera* VII, No. 77 31-46, 147. (Published in Argentina.)

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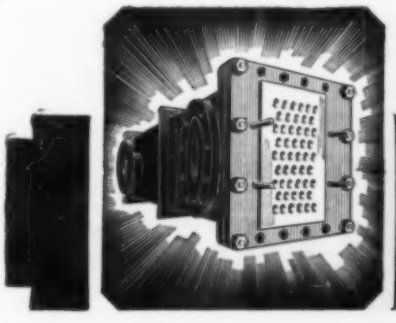

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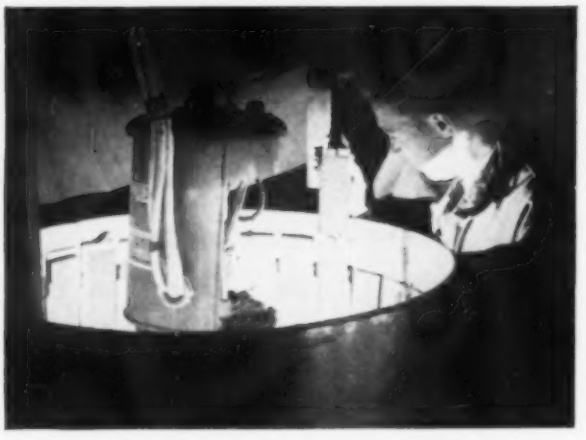

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Lester B. Pope, ASSISTANT EDITOR

Fats and Oils

COTTONSEED AND COTTONSEED PRODUCTS: *Their Chemistry and Chemical Technology. Edited by Alton E. Bailey. Interscience Publishers, New York. 936 pages. $17.50.*

Reviewed by Gordon W. McBride

SECOND of a series of fats and oils monographs, this book gives an immense amount of detail on the chemistry and technology of the cottonseed industry. Contributors to the volume include many outstanding and able authors, both in government and in industry. Representatives of the colleges are also included among the 25 contributors.

Of greatest interest to the chemical engineer are the chapters on processing and utilization of cottonseed and its products. Technology is brought up to date authoritatively.

Supporting these technologic pages are many chapters on the basic scientific data which will be helpful to engineering studies and process development. Properties of cottonseed, all the way from the seed to fertilizers, will be found in varying degrees of detail. The book's value will extend to some degree to the processing of other vegetable oils, as far as general conditions and equipment are concerned, although the basic data are not readily transferable to other vegetable oil raw materials.

Tabular illustrations are liberally employed throughout the book. Pictures, charts, and flowsheets are also numerous. The appearance of the book suffers somewhat from a mixture of two or more kinds of paper bound into the single volume. However, a 14-p. author index and a 16-p. subject index seem quite likely to make this volume a frequently consulted reference work.

RECENT BOOKS RECEIVED

Chemical Russian Self Taught. By J. W. Perry. Journal of Chemical Education. $3.

Crystalline Enzymes. By J. H. Northrop, M. Kunitz & R. M. Herriott. Columbia. $7.50.

Encyclopedia of Chemical Reactions, Vol. II. By C. A. Jacobson. Reinhold. $12.

Fatty Acids and Their Derivatives. By A. W. Ralston. Wiley. $10.

The Genius of Industrial Research. By D. H. Killefer. Reinhold. $4.50.

Isomerism and Isomerization. By E. D. Bergmann. Interscience. $3.50.

Modern Metallurgy of Alloys. By R. H. Harrington. Wiley. $3.50.

Modern Metallurgy for Engineers. By F. T. Sisco. Pitman. $5.

Modern Rubber Chemistry. By H. Barron. Van Nostrand. $7.50.

Petroleum Production, Vol. IV. By P. J. Jones. Reinhold. $5.

Plastics Theory and Practice. By C. C. Winding & R. L. Hasche. McGraw-Hill. $5.

Preparation and Characteristics of Solid Luminescent Materials. By G. R. Fonda & F. Seitz. Wiley. $5.

Quantitative Analysis. 3rd ed. By W. C. Pierce & E. L. Haenisch. Wiley. $3.75.

Collateral Reading

FUNDAMENTALS OF STATISTICS. *By Truman L. Kelley. Harvard University Press, Cambridge. 755 pages. $10.*

Reviewed by Hugh M. Smallwood

THIS text is addressed primarily to workers in psychology, economics, social science and allied subjects. The first few chapters present some of the more elementary aspects of statistics. For example, instructions are given for the most effective way of tabulating data and a detailed description is given of graphic methods of presentation. This part of the text makes no mathematical demands upon the student.

Subsequent chapters contain material of increasing complexity and presuppose considerable mathematical facility. The subjects covered refer, for the most part, to statistics of large samples. The relative merits of the arithmetic mean, the median, the mode, the geometric mean, and the harmonic mean are discussed at considerable length. The normal distribution and its applications form the contents of one chapter, as does a discussion of contingency tables. Three chapters are devoted to the general problem of regression. The two final chapters of the text list a number of miscellaneous topics that may be of interest to the research worker attempting to apply statistics to his particular problems.

The derivations contained in the later phases of the text are, for the most part, heuristic, where any derivation is given. In many instances the author states a formula and leaves it to the student to work out the way in which the formula is to be applied.

Much of the treatment is stimulating and some of the features of the book are to be commended. The importance of the test of significance is given considerable emphasis. In spite of this, some discussion of apparently nonsignificant effects has crept in. The attempt to cut down on the number of statistical tables is certainly praiseworthy, but one wonders whether the labor demanded of the statistician is justified by the relief to the typesetter.

No doubt Professor Kelley is amply qualified to judge the needs of his students. Presumably he has designed a book capable of satisfying those needs. His book, however, will not be particularly helpful to the student of physical sciences. Many topics of importance in chemical work have been omitted. Much that is included is of only incidental interest to the chemist. The style and handling of the mathematics will not appeal to those trained in the physical sciences. For these reasons, Professor Kelley's text can be recommended to the chemist or chemical engineer only as collateral reading, the principal value of which will be to show "how the other half lives."

Reference

POWDER METALLURGY—ITS PHYSICS AND PRODUCTION. *By Dr. Paul Schwarzkopf in collaboration with Dr. C. G. Goetzel, George Stern, Dr. Robert Steinitz and Dr. Werner Leszynski. The Macmillan Co., New York. 397 pages. $8.*

Reviewed by Myron A. Coler

ACCORDING to the preface, "this book is not meant to be a textbook on powder metallurgy, nor a compendium of the knowledge on the subject available today, but rather represents the revised workbook and notebook of a powder metallurgist . . ." It should prove of value as reference material to those al-

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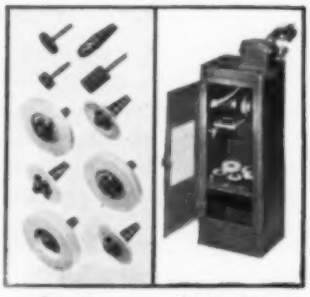

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ready engaged in the field of powder metallurgy and as a source of stimulating orientation to others.

The volume is comprised of three main sections and a supplement. The first part, "processes," discusses metal powders, compacting, sintering, post-sintering treatments and the interrelations between powder characteristics and fabricating conditions. Consideration is given to test methods, equipment design factors, processing atmospheres and more special operations such as hot pressing, centrifugal compacting and repressing.

The second section, "Products," is divided somewhat arbitrarily but conveniently into individual chapters dealing with the following topics: "Dense Materials, Porous Products, Refractory Metals, Hard Metals, Electric Contact Materials, Magnetic Materials, Friction Parts."

The third section, "Theoretical Principles," reviews critically the chief theoretical concepts which have been advanced to explain the phenomena of powder metallurgy. Mechanical properties and fabricating potentialities of sintered and reguline metals are considered from the standpoint of their morphologies. The mechanism of diffusion in solid solutions and the predominantly nonequilabrated nature of powder metallurgy products are emphasized.

The supplement takes cognizance of the rapid development of the field and a substantial number of significant papers which have appeared subsequent to the completion of the main manuscript as well as several prior omissions. It follows the pattern of the three major sections and describes recent developments with respect to processing products and theoretical principles. References run through 1946 and into 1947.

A brief fourth section, entitled "Future Developments," together with the preface, introduction and a foreword serve to point up the underlying approach and somewhat personalized philosophy of the author. Dr. Schwarzkopf refers with pride to the indispensable contributions of powder metallurgy to the incandescent lamp, television, radar, proximity fuse, etc. He is optimistic with respect to the future. The facts and interpretations which this volume provides, appear to justify his pride and optimism.

The book is well documented; each main section and the supplement carries a bibliography providing, in total, almost 600 pertinent references. Additional information is conveyed by means of 90 tables and more than 160 figures. The over-all format is pleasing although it would have been preferable to have distributed the material

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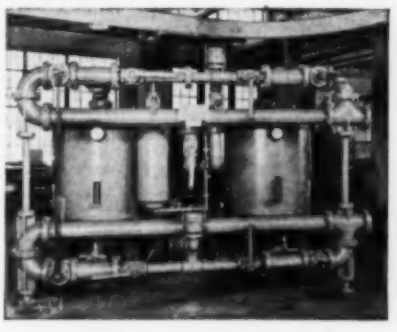

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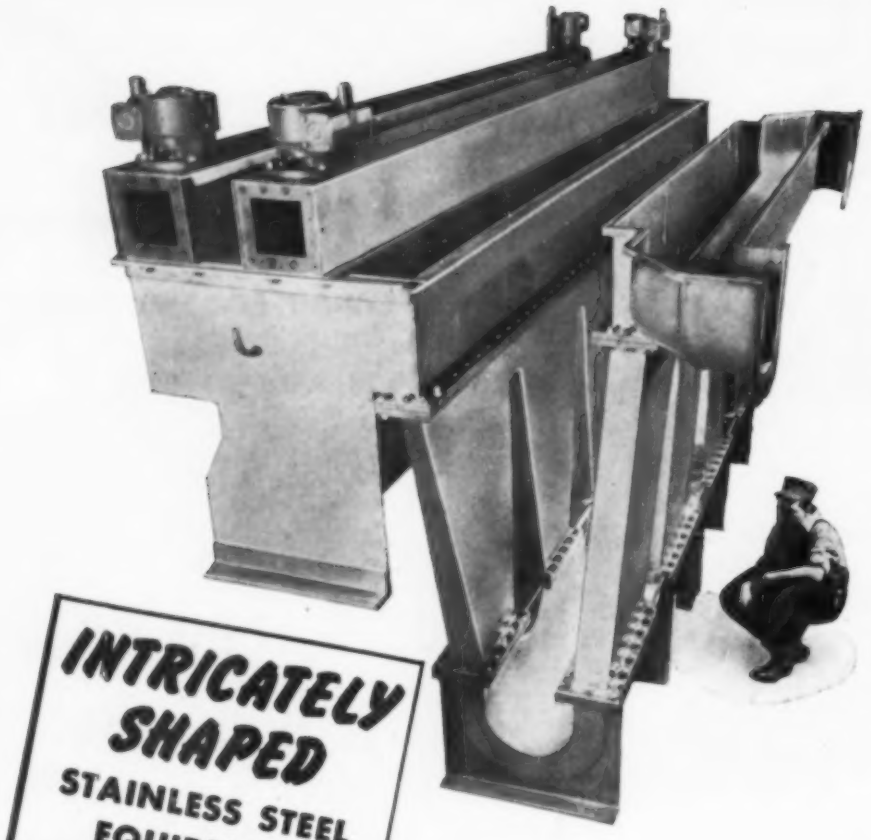

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of the supplement over the appropriate corresponding portions of the text.

From Holland

HET KRISTALLISATIEPROCES DOOR. *G. H. De Vries overgedrukt uit het "Chemisch Weekblad," No. 6/7 1947. D. B. Centen, Amsterdam.*

Reviewed by F. C. Nachod

MIJNHEER DE VRIES heeft een artiekel aan de Kristallisatieproces geschreven dat is nu gepubliceerd in de form van een klein boekje. Het handeled over de theoretische beschouwingen, b.v. evenwichtoestand, oververzadiging, kiemvorming, en kristalgroei, en over praktische aanwending van de techniek der kristallisatie voornamelijk en de suiker industrie.

From France

ANALYSE COLORIMETRIQUE. *Par B. Lange. Traduite par Georges Dufrasne. Dunod Editeurs, Paris. 378 pages.*

Reviewed by F. C. Nachod

M GEORGES DUFRASNE de l'Université libre de Bruxelles, a traduit la troisième édition de l'oeuvre allemande du Doctor B. Lange. Il est bien vrai que "La science d'auiourd'hui est la technique de demain."

La matière comporte six chapitres. Ces chapitres traitent la théorie et les appareils, les méthodes colorimétriques en chimie inorganique et organique, applications en chimie physicale, en médécine et en biologie et finalement, quelques exemples pour l'examination des denrées alimentaires.

Le premier chapitre qui n'a que de l'utilité limitée pour l'audience dans les Etats Unis, parce que les appareils existants ici sont différents et peut-être un peu plus modernes que leur contre-part en Europe. Mais les portions de cet oeuvre qui décrivent les méthodes et les applications des techniques colorimétriques sont vraiment exceptionelles et consistent en références très utiles.

From Germany

GRUNDGESTZE DER REGELUNG (BASIC THEORY OF AUTOMATIC CONTROL). *By Winifred Oppelt. Wolfenbutteler Verlaganstalt G. m. b. H. Wolfenbuttel—Hannover. 118 pages.*

Reviewed by H. L. Mason

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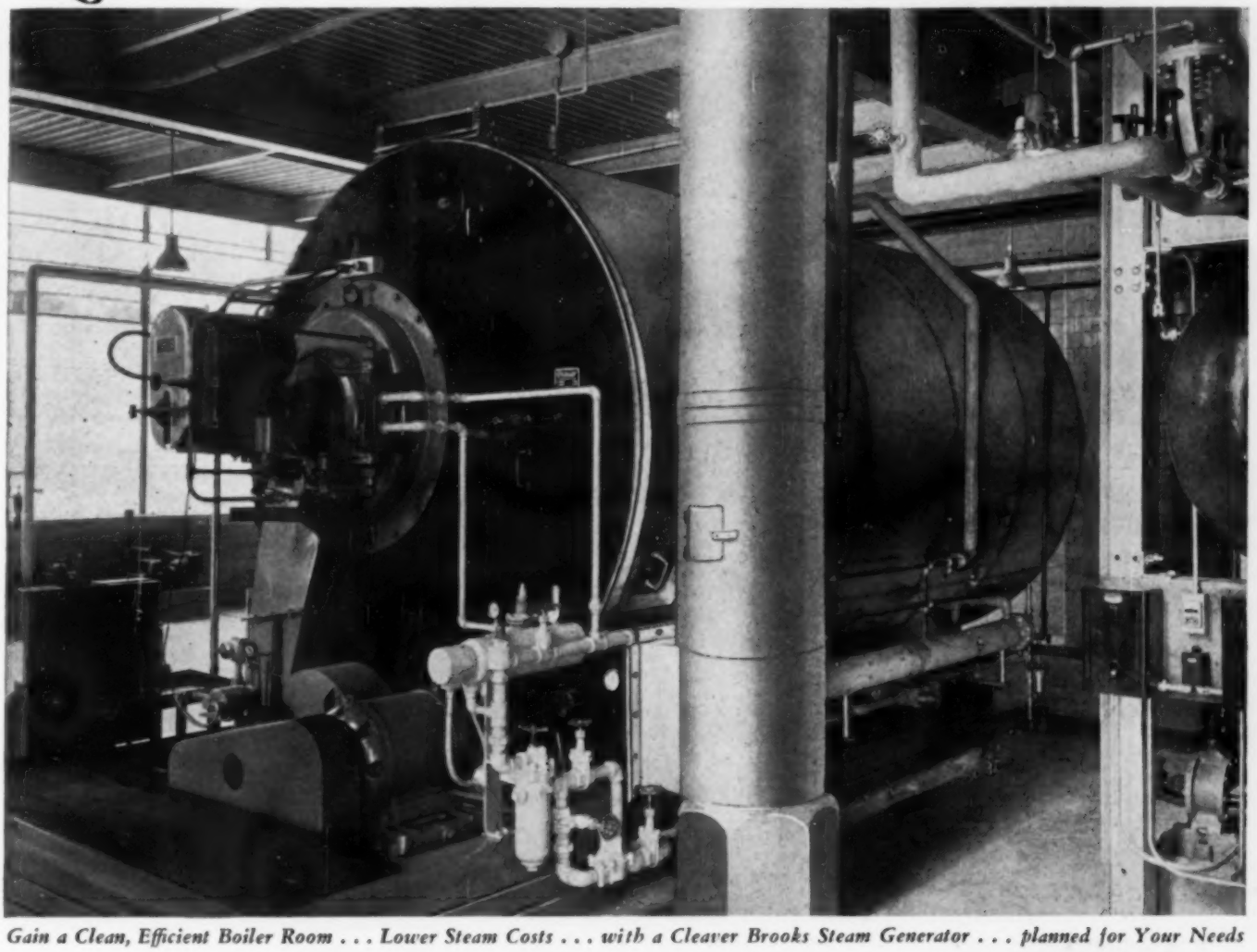

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by continuous variables which are related by linear differental equations. He says it was written for students. Few proofs are given, but the ideas are developed in logical sequence, and there are plentiful bibliographic footnotes. Knowledge of differential equations and of vectorial graphics is assumed.

Constructional detail is shown schematically for such physical apparatus as sensing elements, relays, transducers, follow-ups, derivative devices, and servomotors. After a brief statement of the basic relation between differential equation, transfer locus for sinusoids, inverse locus, and response curve for unit step, these forms of representation are given for passive components, for characterizer components, for combinations sequenced or manifolded, and for closed loops subjected to load change or set-point change. Finally, there is a description of stability criteria, for components and loops, based on the above forms.

Small Particles

MICROMERETICS. *Second Edition. By J. M. Dallavalle. Pitman Publishing Corp. New York and London. 555 pages. $8.50.*

Reviewed by Alan R. Lukens

IN HIS second edition, Dr. Dallavalle has enlarged his first work by about 20 percent. He now presents a more complete and better balanced test.

The technology of fine particles, aptly named Micromeretics by the author, is finding increasing recognition as a useful subject for engineering students. Small particles contribute much to life as we find it. Color in the atmosphere, texture of the soil, the menace of dusts and smokes, structural firmness to paints, rubber and pavements, efficacy to drugs, all of these are promoted by powdered materials.

The college professor, seeking an excellent text book with which his students may study and review fundamentals of this art, will find it here. To every chapter, he will find appended thought provoking problems. Many educators will revel in the profuse recourse to mathematical exposition and approve the space used in expanding thereof.

It is indeed difficult to suggest means of improvement because of the thorough coverage of the dynamics, the chemical, electrical, sonic, optical and surface properties of small particles, one will find in this book.

In Chapter 3, where the shape and size distribution of particles is covered, the inclusion of the early (1927) work of Loveland and Trivelli, published in

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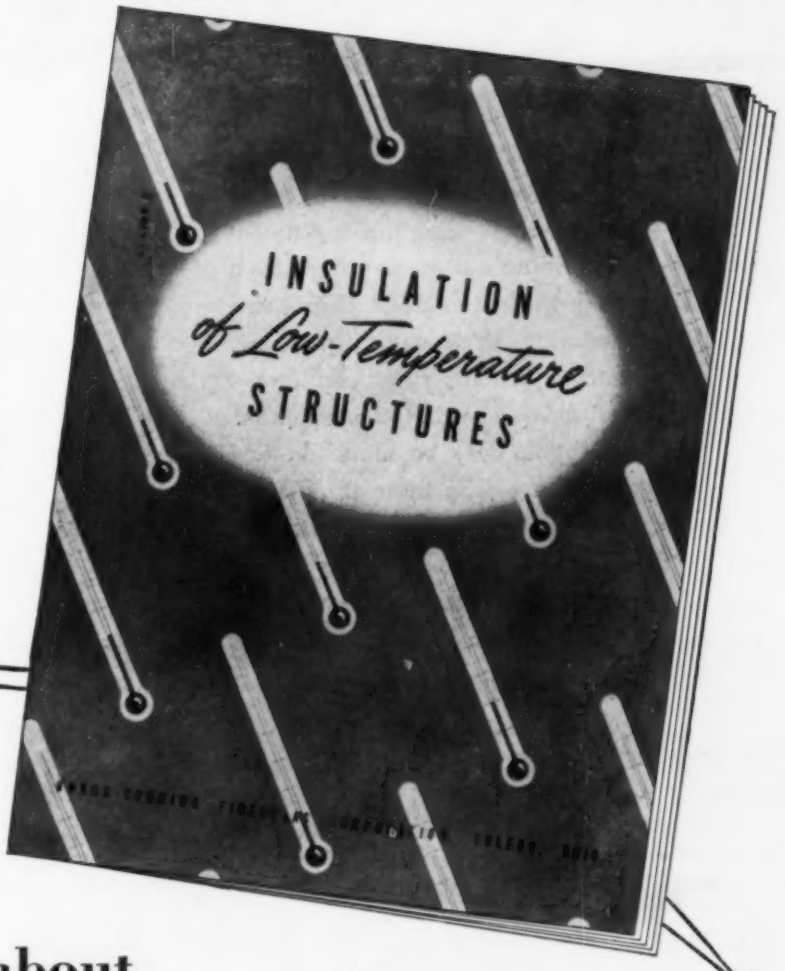

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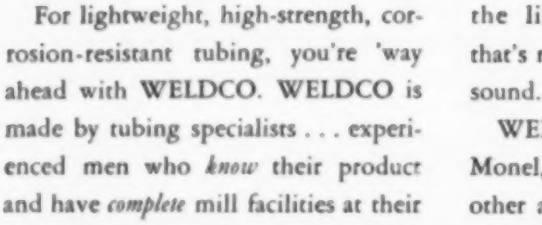

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the *Journal* of the Franklin Institute would appear justified, particularly in view of the credit given to Hatch and Choate for later work.

Sedimentation methods for measuring particle size, grow in favor. The author has recognized this more fully, in this second edition. He has improved his description of the widely used hydrometer method. He skips too lightly over the necessity for nothing less than complete dispersion. He gives a good procedure for the deflocculation of soils, but particulates, used in quantities approaching a million tons annually in ceramic, paper, paint and rubber industries, are largely ignored.

Industrial and social hygienists will find in Dr. Dallavalle's book an increased wealth of information. Engineers, too, will find good coverage upon the transport of small particles in fluids, both liquid and gaseous.

A recent dust explosion in a Massachusetts plastic molding factory killed and injured many. Had the value of intelligent surveys been recognized either by the plant owners or demanded by local health authorities, this catastrophe might have been avoided. Good treatment of this subject is available in the chapter on the chemical properties of small particles.

The author's treatment of fine grinding might be increased. Little or no mention is made of recent advances in fluid energy grinding nor do we find mention of the rapidly increasing use of centrifuges for classification when grinding is done in water.

The chapter on sampling is well done and welcome.

Printing is good, the editing excellent. No excuse is given by the publishers for the paper used. Such a splendid text deserves the best paper now available.

To Disabuse Infrared

INDUSTRIAL APPLICATIONS OF INFRARED. *By James D. Hall. McGraw-Hill Book Co., New York. 201 pages. $3.50.*

Reviewed by James A. Massaro

THE ADMITTED purpose of the book is to provide a non-technical source of reference, which purpose the book accomplishes very well. Emphasis is placed upon the practical rather than the theoretical aspects of the use of infrared. In this regard, the author is to be commended particularly for the presentation in the introduction, in less than 12 pages of an extremely lucid background of all the theory that the layman requires to understand and intelligently use infrared heat. Aside from this opening chapter, all other theoretical considerations are kept at a minimum. In addition,

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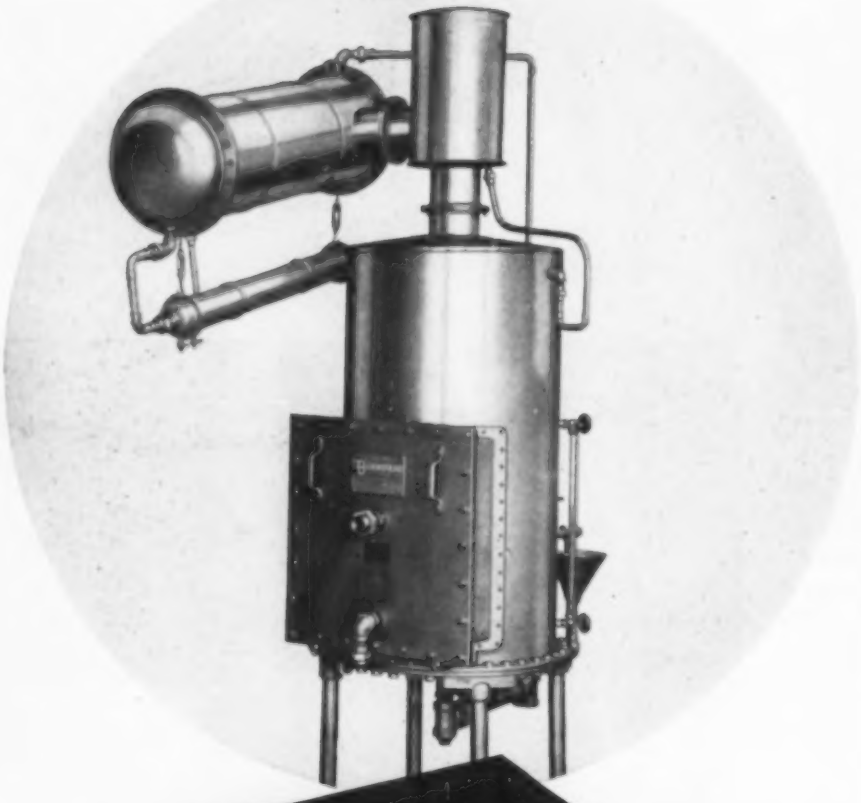

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much stress is placed upon photographs, sketches, and graphs which illustrate quite vividly the flexibility, speed, and safety of infrared heat in an imposing and impressive variety of industrial and related applications, including the baking of paint and allied finishes. The use of visual instruction is an elementary but very effective technique in that it serves to project ideas and stimulate interest to a very high degree. The appendix must be rated good, since it deals with the effect of infrared radiation on the human body, discusses interesting miscellaneous uses, tabulates specific heats of common materials, and provides a temperature conversion table up to 3,000 deg. C. or 5,431 deg. F. The only feature in the book that might be considered lamentable is the poor arrangement of the 61 references in the bibliography. They are listed by title of articles and books, not alphabetically, when it would have been much better to have listed them by authors, alphabetically. Aside from this one criticism, I believe that the book marks a definite step forward into the frequently misunderstood and abused field of infrared radiation.

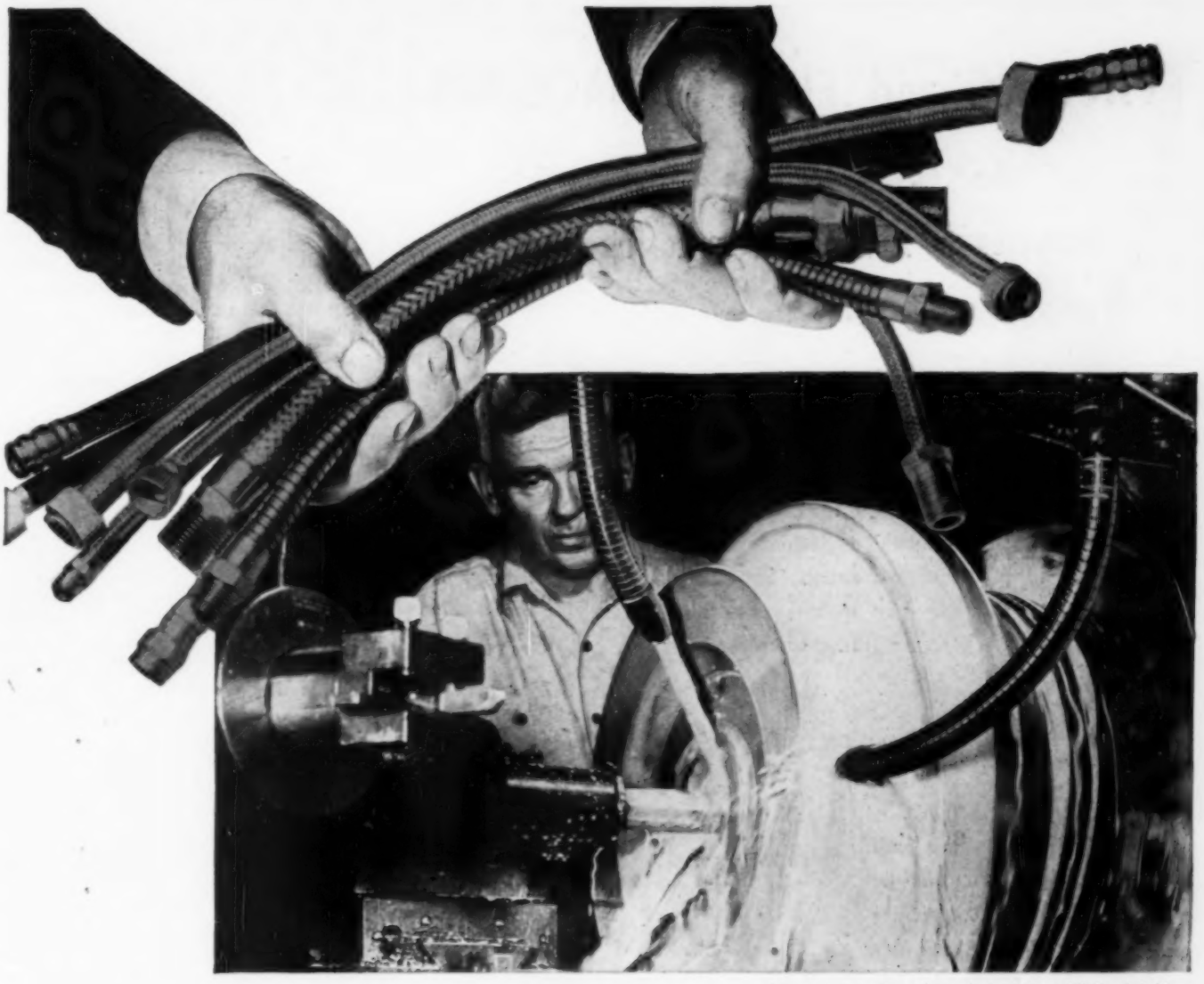
Statistical Tools

EXAMINATION OF INDUSTRIAL MEASUREMENTS. *By John W. Dudley, Jr., McGraw-Hill Book Co., New York.* 109 *pages.* $2.

Reviewed by J. W. Dudly

THE AUTHOR states in the preface that the purpose of the book is "to acquaint the engineer with some useful, simple, and adaptable statistical tools and to enable him to collect data in such a manner that they can be subjected to more elaborate analyses when such analyses are necessary and justified". This is a big undertaking especially for the limited space of 109 pages. However, by the frequent use of practical examples and the avoidance of mathematical statistics, the main purposes of the book are accomplished. This book will be of special interest to the engineer or chemist with no formal training in or experience with statistical methods and procedures. An awareness of what statistics can do should stimulate the interest of the chemist or engineer and even though the reader may not obtain sufficient grasp of the subject to apply readily all the techniques, he will at least appreciate the desirability and necessity of examining data statistically. A short but excellent bibliography is included.

The first portion of this book is devoted to a brief and simple discussion of the various types of industrial data such as inspection by



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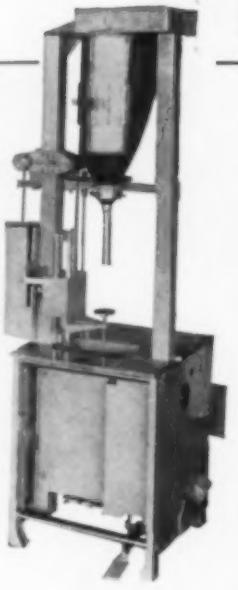

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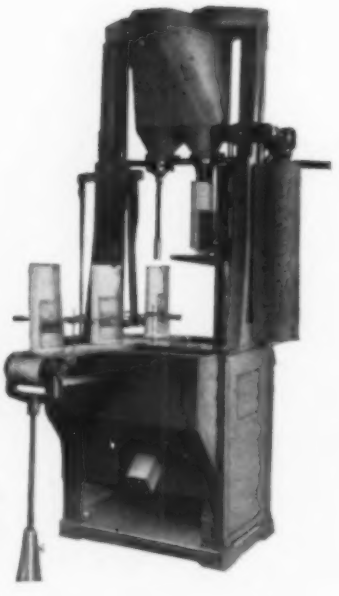

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variables and by attributes, research and pilot plant data, plant maintenance, cost and personnel records; all of which serves to indicate the many places where statistical methods can be applied.

Brief chapters on random variation, methods of presenting data and the normal probability curve serve as a good introduction to the chapters on the use of the quality control chart. Convenient tabulation of formulas and constants, together with some half a dozen practical illustrative examples contribute materially to a simple and clear cut presentation of this useful concept.

There are also described and illustrated control chart techniques for determining whether differences in two or more batches, runs, etc. are significant. A chapter on examination by means of runs describes a simple and very useful method for analyzing variations in a given set of values by considering the number and length of consecutive observations above or below the central or average value of the set. For example, in a series of 256 measurements there should be only one run of seven consecutive values above or below the grand average if the variations in the system are within the range of normal probability.

The chapters on correlation and curve fitting of control limits for fitted curves provide additional applications of statistical methods.

A practical problem, more common to the mechanical rather than chemical industries is one of determining the number of samples to select and the allowable number of defects or defectives in that sample in order to assure acceptance of lots of satisfactory quality. A brief discussion of this problem perhaps should have been included.

Otherwise, this book is an excellent primer and is recommended for the engineer or chemist interested in the meaning of his measurements.

Translation

NEWER METHODS OF PREPARATIVE CHEMISTRY. *First American Edition. Interscience Publishers, New York.* 670 *pages.* $8.50.

Reviewed by Edgar A. Steck

IT IS becoming more a pleasure to study reference books which have been translated by Americans. In previous years, our British colleagues towered far above us in the faithful translation of attitudes as well as words, but "Newer Methods," demonstrates our prowess again. This volume, originally a German kin to "Organic Reactions," is not to be

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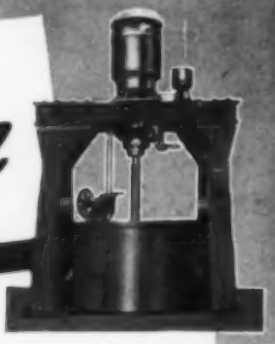

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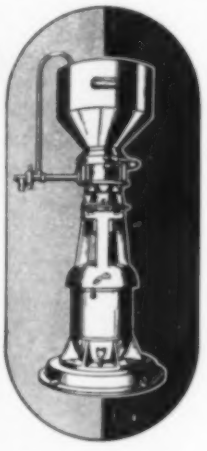

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RECENT BOOKS and PAMPHLETS

Instrumentation and Control in the German Chemical Industry. By C. H. Gregory et al. Published by Mapleton House, 5415 17th Ave., Brooklyn 4, N. Y. 157 pages. $6. Report of a two-month investigation of 23 chemical plants and 18 instrument firms. The report is well organized and broken down into topics: flow, pressure, liquid level, temperature, density, analysis measurements and automatic control. A comprehensive BIOS report.

Aluminum and Its Applications. Hiram Brown (in collaboration with twelve specialists). Pitman Publishing Corp., New York. 338 pages. $5.75. Fundamental properties of alloys, fabrication methods, and applications in specific industries, including the chemical.

Engineering Laminates, Fundamentals Underlying the Problems of Their Inhomogeneity. By Walter C. Voss. Published by American Society for Testing Materials, 1916 Race St., Philadelphia. 34 pages. $1. Common laminates and methods of evaluating their properties. Includes 33 figures and several tables.

Rubber in Textile Factories. By Colin MacBeth. Published by British Rubber Development Board, Market Buildings, Mark Lane, London, E. C. 3, England. 135 pages. Gratis. Review of the known uses of rubber in the textile industry.

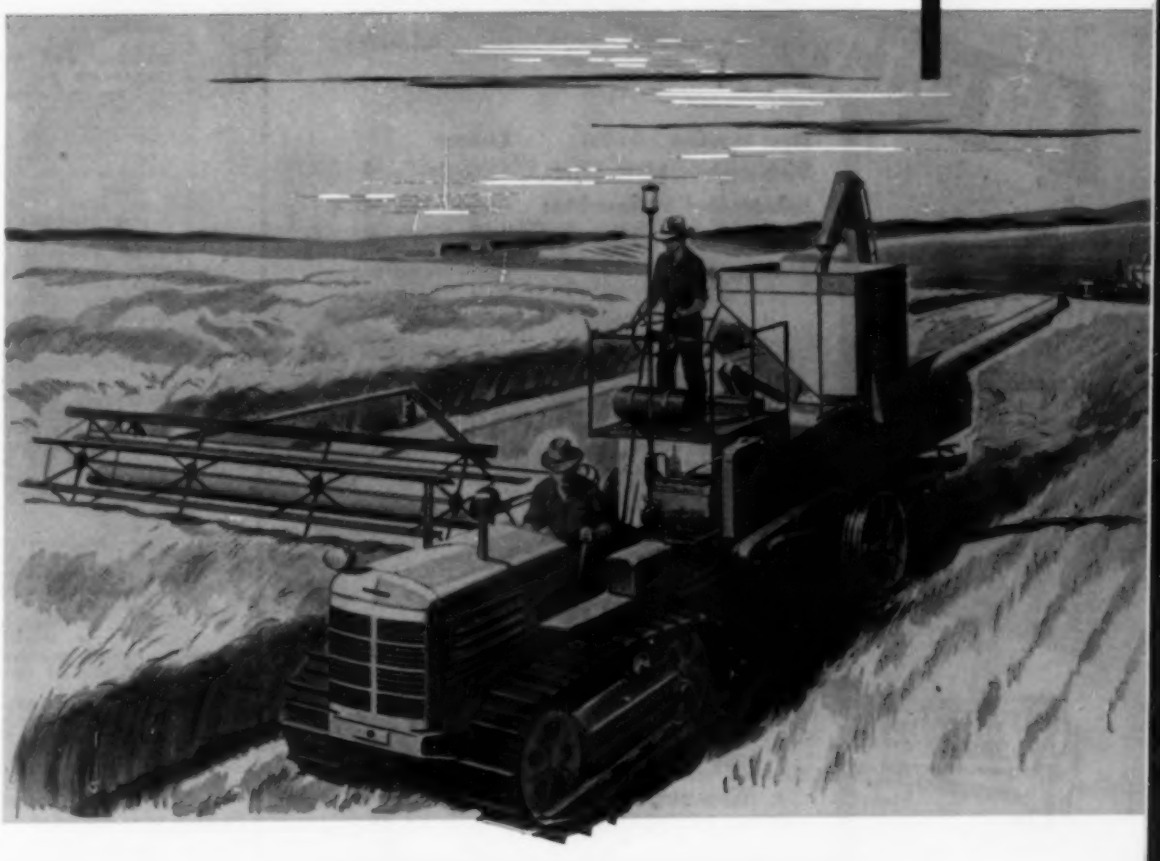
The Fracture of Metals. By M. Gensamer, E. Saibel, J. T. Ransom and R. E. Lowrie. Published by the American Welding Society, 33 West 39th St., New York. 84 pages. $1. Compilation of the laws and fundamental mechanism of fracture.

Nature of the Chemical Components of Wood. Edited by C. J. West. Monograph Series—No. 6, published by the Technical Association of the Pulp and Paper Industry, 122 East 42nd St., New York. 234 pages. A symposium covering cellulose, hemicelluloses, gums and mucilages, lignin, phenolic constituents, tannins, wood resins, coloring matters, and synthetic lignin.

Annual Report of The National Council for Stream Improvement. Published by the National Council for Stream Improvement, 271 Madison Ave., New York. 28 pages. 1947 report. Pulp, Paper and Paperboard Industries Inc.

Nitrobenzene. Chemical Safety Data Sheet SD-21, published by the Manufacturing Chemists' Association, 608 Woodward Building, Washington 5, D. C. 12 pages. 20 cents. Safe handling and use.

Forming of Austenitic Chromium-Nickel Stainless Steels. By Vsevolod N. Krivobok and George Sachs. Published by the International Nickel Co., Inc., 67



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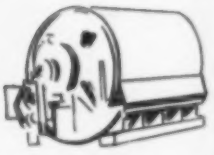

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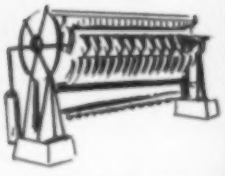

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Wage, Hour, Employment, Production and Price Trends in the Chemical Industry as Compared With All Manufacturing. Statistical Report No. 26, published by Manufacturing Chemists' Association, 608 Woodward Bldg., Washington 5, D. C. 23 pages.

Chemical Engineering Group Proceedings. Vol. 26, 1944. Published by the Society of Chemical Industry, 56, Victoria St., London, S.W. 1, England. 160 pages.

Technical Association Papers. Edited by Ronald G. MacDonald and R. T. Bingham. Thirtieth Series, published by the Technical Association of the Pulp and Paper Industry, 122 East 42nd St., New York. 765 pages. Record of technical development in the pulp and paper and related industries for 1946-1947.

Heating and Ventilating's Engineering Databook. By Clifford Strock. Published by the Industrial Press, 148 Lafayette St., New York. 576 pages. $7. Ten sections: Heat and Moisture in Air, Fuels and Combustion, Piping, Air Handling and Ventilation, Heating and Heat Transmission, Cooling and Air Conditioning, Motors and Drives, Contract Law, Mathematical Data and Drafting Room Practice, and Terminology.

Yeast From Florida Sulfite Waste Liquor. By Robert D. Walker, Jr. Technical paper No. 16, published by Florida Engineering and Industrial Experiment Station, College of Engineering, University of Florida, Gainesville, Fla. 152 pages. The Quarterly Journal of the Florida Academy of Sciences.

Corrosion Studies. By Albert L. Kimmel. Bulletin No. 17, published by the Florida Engineering and Industrial Experiment Station, College of Engineering, University of Florida, Gainesville, Fla. 40 pages. Mechanical, chemical, and electrical methods for slowing down corrosion.

The Engineering Societies Yearbook, 1948. Published under the sponsorship of the Engineers Joint Council by the American Society of Mechanical Engineers, 29 West 39th St., New York 18, N. Y. $3. Reference source on purposes, activities, membership, etc. of 8 international engineering organizations, 275 U. S. and 35 Canadian societies.

FIAT Reports. Publication PB-86000, Office of Technical Services, Department of Commerce, Washington 25, D. C. $5. A bibliography and index of reports on German industry. 1,200 reports based on American investigations directed by Field Information Agency, Technical (FIAT).

Capital Goods Industries and Tax Reform. Published by Machinery and Allied Products Institute, 910 17th St., N. W., Washington 6, D. C. 25 cents. Concerned primarily with effect of taxation on the production of capital goods. Considers impact of taxation on the process of capital formation and investment.

Lecture Series in Nuclear Physics. MDDC 1175 for sale by Superintendent of Documents, Washington 25, D. C. 132 pages. 55 cents. Prepared in 1943 by eight experts for use at the Los Alamos Scientific Laboratory.

A History of the Petroleum Administration for War, 1941-1945. Edited by J. W. Frey and H. C. Ide. For sale by the Superintendent of Documents, Washington 25, D. C. 463 pages. $3. A complete history of PAW. Well illustrated with dramatic photographs and charts.

Stop that Cold. By Harry J. Johnson. Published by Prentice-Hall, 70 Fifth Ave., New York 11, N. Y. 15 pages. 18 cents with discounts on quantity orders. Discusses the prevention of the common cold and methods of minimizing the effects of a cold. Prepared for employers to distribute to employes to cut down absenteeism.

Toxaphene, A Chlorinated Hydrocarbon with Insecticidal Properties. By W. Leroy Parker and John H. Beecher. Bulletin No. 264, Technical No. 36, published

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by the University of Delaware Agricultural Experiment Station, Newark, Del. 28 pages. Gratis. Physical and chemical data on toxaphene and tables showing its effectiveness against various insects in comparison with other insecticides.

Bibliography on High-Frequency Dielectric Heating. By Ralph A. Rusca. Published by the American Institute of Electrical Engineers, 33 West 39th St., New York. 19 pages. 75 cents. Covers publications from 1925 to July 31, 1946.

What Makes a Plant Fire-Safe? Published by the Associated Factory Mutual Fire Insurance Cos., 184 High St., Boston. 16 pages. Gratis. Illustrated booklet outlining the planning of plant fire safety.

GOVERNMENT PUBLICATIONS

The following recently issued documents are available at prices indicated from the Superintendent of Documents, Government Printing Office, Washington 25, D. C. In ordering publications noted in this list always give complete title and the issuing office. Remittances should be made by postal money order, coupons or check. Do not send postage stamps. When no price is indicated, pamphlet is free and should be ordered from the bureau responsible for its issue.

Porcelain-Enameled Steel Utensils. National Bureau of Standards, Commercial Standard CS100-47. Price 10 cents. Includes technical definitions, but not complete specifications.

Gas Calorimeter Tables. By Ralph S. Jessup and Elmer R. Weaver. National Bureau of Standards, Circular 464. Price 15 cents. Includes comprehensive tables for calculating gas volumes under different temperatures and pressures and for atmospheric humidity calculations of more general significance than for gas-calorimeter use.

Wood-Sugar Molasses From Wood Waste. By Elwin E. Harris. Forest Products Laboratory, Madison 5, Wis. No. R1704. Includes suggested process and process flowsheet with estimates of cost.

Forest Products Bibliographies. Available from Forest Products Laboratory, Madison 5, Wis., are bibliographies on a number of subjects indicating literature issued by the Lab as a result of extended investigations, including: (1) Pulp and Paper; (2) The Seasoning of Wood; (3) Box and Crate Construction and Packaging Data.

Glue and Plywood. Forest Products Laboratory, Madison 5, Wis. has recently issued a number of mimeographed documents available on request covering general and detailed reports, including: (1) Bibliography on Glue and Plywood, R513; (2) Wood Treatment with Resin-Forming Systems, R1703; (3) Synthetic-Resin Glues, 1336, revised January 1948; (4) Fatigue of Sandwich Construction, 1559-A; (5) Durability of . . . Yellow Birch Plywood, 1537; (6) Torsional Buckling of Plywood Cylinders, 1563; (7) Development of Strength in Glued Lap Joints, 1565.

Bibliography of Some Recent Research in the Field of High Polymers. Supplement to Letter Circular LC871 National Bureau of Standards. Mimeographed. Contains a reference list of papers which appeared in American and foreign scientific periodicals from April or May to December 1947.

Health of Arc Welders in Steel Ship Construction. Public Health Bulletin No. 298. Price 55 cents. Applicable also to industrial welding safety.

Public Water Supplies in Eastern Texas. By R. W. Sundstrom, et al. Geological

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Survey Water-Supply Paper 1047. Price 50 cents. Prepared in cooperation with the Texas State Board of Water Engineers.

Tables of the Bessel Functions. National Bureau of Standards, Applied Mathematics Series 1. Price 25 cents.

Atomic Energy Levels. National Bureau of Standards, Circular No. 467. Price 50 cents. Up-to-date compilation of the energy levels of the elements as derived from observations of atomic spectra.

Inhibition of Plant Growth by Emanations from Oils, Varnishes, and Woods. By Robert L. Weintraub and Leonard Price. Smithsonian Institution, Publication 3912. Price 30 cents. Order from The Smithsonian Institution, Washington, D. C.

United States Associations in World Trade and Affairs. By Jay Judkins. U. S. Department of Commerce, Industrial Series No. 70. Price 30 cents. Directory of 900 organizations in 190 cities in the United States which have a special interest in foreign trade, international affairs, or world peace; also text and statistics on the foreign trade of the United States and other nations.

Ammonium Nitrate for Crop Production. By Colin W. Whittaker, et al. Department of Agriculture, Circular 771. Price 10 cents.

List of Respiratory Protective Devices Approved by the Bureau of Mines. By H. H. Schrenk. Bureau of Mines, Information Circular I. C. 7444. Mimeographed. Describes available facilities and their commercial sources.

Mining Methods and Practices, Potash Co. of America, Eddy County, N. Mex. By Walter R. Storms. Bureau of Mines, Information Circular I. C. 7445. Mimeographed. Emphasizes principally geologic occurrence and mining methods, with limited attention to processing.

Protection Against Lightning at Surface and Underground Mining Plants. By D. Harrington, et al. Bureau of Mines, Information Circular I. C. 7447. Mimeographed. Precautions easily adaptable to process industry.

Petroleum Refineries, Including Cracking Plants, in the United States, January 1, 1947. By F. S. Lott. Bureau of Mines, Information Circular I. C. 7455. Mimeographed. A directory of the industry.

Damping Capacity of Metals. By E. V. Potter. Bureau of Mines, Report of Investigations R. I. 4194. Mimeographed. A discussion of damping capacity as it related to dissipating of vibrational energy. Fundamental scientific physical study.

Investigation of Arkansas Bauxite. Vol. I. By M. C. Malamphy, et al. Bureau of Mines, Report of Investigations R. I. 4251. Mimeographed. Vols. II and III of this series deal solely with highly detailed geologic survey of some of the deposits.

Titanium Minerals in Trail Ridge, Fla. By Robert V. Spencer. Bureau of Mines, Report of Investigations R. I. 4208. Mimeographed. A field survey.

Flocculation of Aerosols by Intense High-Frequency Sound. By H. W. St. Clair, et al. Bureau of Mines, Report of Investigations R. I. 4218. Mimeographed. Laboratory inquiry of supersonic phenomena of broad significance.

Preparation and Carbonization Characteristics of Low-Volatile Coal from Oyon Region of Peru. By Thomas Fraser and J. D. Davis. Bureau of Mines, Report of Investigations R. I. 4222. Mimeographed.

A Spectroscopic Method for the Determination of Absorption Coefficients. By Graham W. Marks and Harold C. Lukens. Bureau of Mines, Report of Investigations R. I. 4242. Mimeographed.

Edison Spodumene Mine, Pennington County, S. Dak. By Fremont F. Clarke, et al. Bureau of Mines, Report of Investigations R. I. 4234. Mimeographed.

Bauxite Deposits in Union and Pontotoc Counties, Miss. By Don M. Coulter. Bureau of Mines, Report of Investigations R. I. 4235. Mimeographed.

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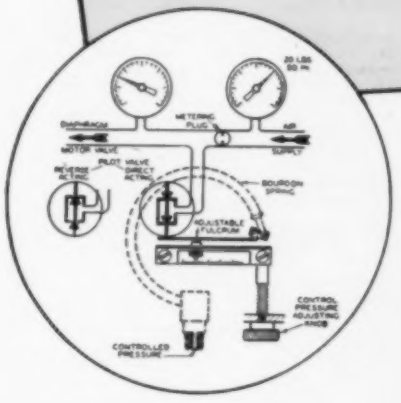
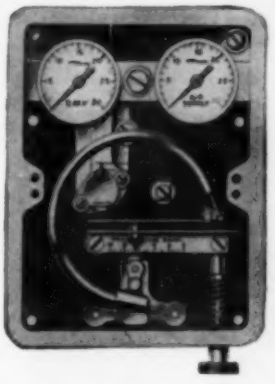


Schematic diagram and internal view of Series 46 Kontrol Master Pilot



- **VACUUM TO 10,000 LB.**
- **REDUCING OR BACK-PRESSURE**
- **CLOSE-COUPLED OR REMOTE**

TYPES

46-V—Valve mounted, side connected
46-S—Panel or wall mounted, side connected
46-B—Panel or wall mounted, back connected

PRESSURE RANGES

(BRONZE TUBE)

0-30 lb.	0-200 lb.
0-60 lb.	0-300 lb.
0-100 lb.	0-600 lb.
0-1000 lb.	

(STEEL TUBE)

0-30 lb.	0-300 lb.	0-2000 lb.
0-60 lb.	0-600 lb.	0-3000 lb.
0-100 lb.	0-1000 lb.	0-5000 lb.
0-200 lb.	0-1500 lb.	0-10,000 lb.

Write for 100-page catalog "Automatic Equipment for Pressure and Level Control."

Vernier adjusting screw—either inside or outside the weather-proof, gas-tight case—enables Kontrol Master Pressure Pilots to adjust to unusually fine pressure settings.

Used with K&M Kontrol Motor Diaphragm Valves, Kontrol Master Pilots can be mounted right on the valve or, if more convenient, on a remote panel or wall. Air supply and controlled pressure connections can be at back or through side of case, as requirements dictate.

Many features of more expensive instrument-type controllers are offered in this accurate and versatile unit. Throttling range is easily adjusted by means of a thumb screw. Variations in proportional band of from 1% to 75% of the pilot pressure range can be quickly effected by merely sliding the thumb screw along its slot. Changes from direct to reverse action (or vice versa) are made in less than a minute—without disturbing bourdon tube or nozzle block.

If sensitive and flexible pressure control is important in your process, it will pay you to get full details on Kontrol Master pneumatically operated pressure pilots. Kieley & Mueller, Inc., North Bergen, N. J.

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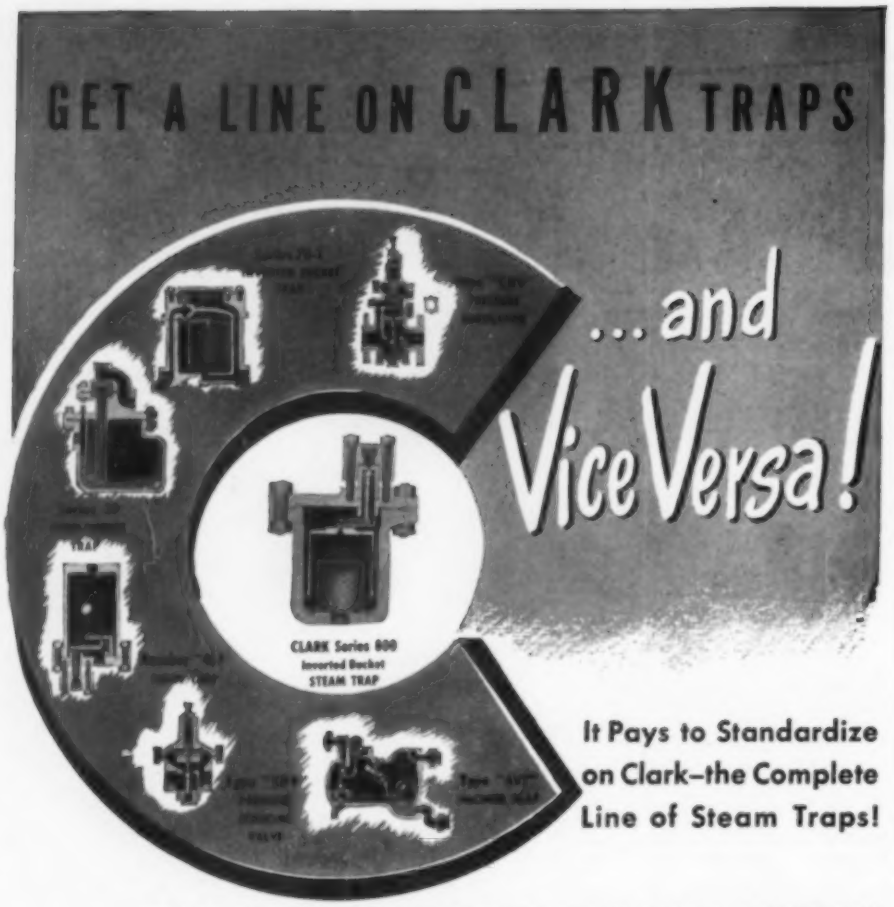

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MANUFACTURERS' PUBLICATIONS

(*Continued from page* 164)

similar articles. It is a manually-operated device that lifts, grips and carries cylindrical objects.

112. Hydraulic Presses. The Hydraulic Press Mfg. Co., Mt. Gilead, Ohio—8-page booklet listing hydraulic equipment available for quick delivery from this company. Includes metal-working presses, die-casting machines, plastic molding machines, turbojectors for rubber molding, laboratory presses, hydraulic boosters, gear pumps, etc.

113. Valves. Caton Co., Newark, N. J.—6-page leaflet illustrating and describing the solenoid operated and other types of specialty valves made by this company.

114. Magnetic Separators. Dings Magnetic Separator Co., Milwaukee, Wis.—Two-page leaflet No. B-1009-A describing and illustrating this company's Alnico Perma Pulley Magnetic Separators.

115. Testing Equipment. The Baldwin Locomotive Works, Philadelphia, Pa.—4-page booklet No. 282 describes and illustrates the Baldwin-Tate-Emery Universal Testing Machine. Describes principles of operation, and gives information on accessories, together with specifications.

116. Instruments. Fischer & Porter Co., Hatboro, Pa.—Catalog Section 30-D illustrates and describes the C-Clamp Flowrator instruments used for replacing bubbler-type liquid-filled purge line meters. Catalog Section 31-F is a two-page leaflet describing the Junior Flowrator instruments. These are small, self-contained units for measuring flows of various liquids or gases in purge systems, bleed lines, or for chemical feed service.

117. Tube Cleaners. Elliott Co., Jeannette, Pa. Bulletin Y-26. 4-page booklet illustrating and describing the LaGonda air and water-driven cleaners for boiler tubes and general service.

118. Batteries. Gould Storage Battery Corp., Trenton, N. J.—16-page brochure describing the new research laboratory of this company. Contains information on the various research activities carried out in the laboratory.

119. Rotameters. Brooks Rotameter Co., Lansdale, Pa.—Bulletin No. 2. 4-page booklet illustrating and describing this company's rotameter for flow recording, controlling, or totalizing. Principle of operation is illustrated and described and typical application diagram is given.

120. Hose Fittings. B. F. Goodrich Co., Akron, Ohio—Catalog Section 3,100 contains six pages cataloging the various types of hose fittings available from this company.

121. Bearings. General Motors, New Departure Div., General Motors Club, Bristol, Conn. 20-page booklet contains a brief outline of the principal steps required in developing a successful ball bearing mounting. This is the 5th in a series of engineering service booklets on the general subject of bearings.

122. Air Filters. Dollinger Corp., Rochester, N. Y.—Bulletin S.I.F. contains 8 pages describing the complete line of Staynew Dry-type intake air filters for all types of air compressors, diesels and gas engines, blowers, motors and generators.

123. Alloy Castings. International Nickel Co. Inc., New York, N. Y. Eight page booklet lists the facilities and locations of various producers of Ni-Hard specialties.

124. Welding. Air Reduction Sales Co., New York, N. Y.—40-page pocket guide, a compilation of facts pertaining to the most commonly used welding electrodes, together with helpful data regarding the factors to be considered when selecting electrodes.

125. Speed Changers. Metron Instruments Co., Denver, Colo.—Bulletin No. 100 contains four pages describing and illustrating miniature speed changers for use on instruments, controls, regu-

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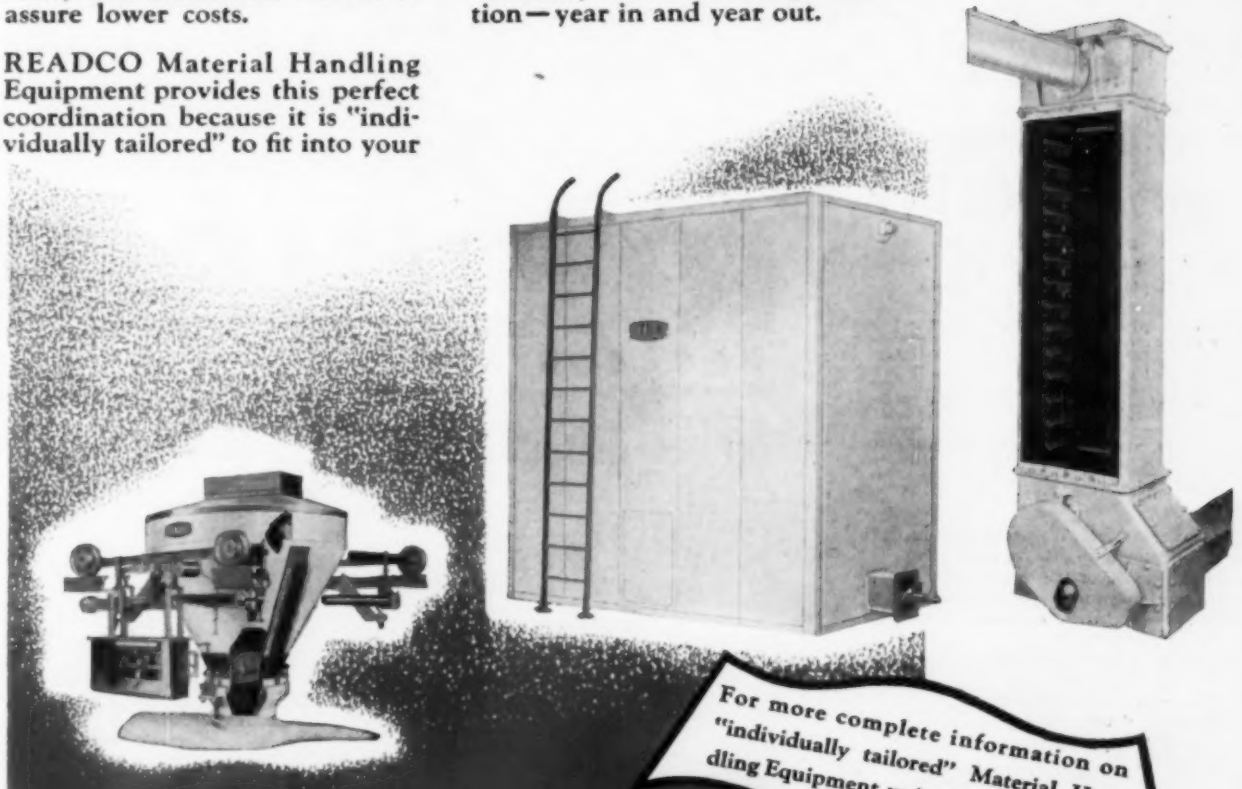

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126. Materials Handling. The Rapids-Standard Co. Inc., Grand Rapids, Mich.—2-page leaflet featuring the hand trucks made by this company.

127. Alloys. Norton Co., Worcester, Mass.—4-page leaflet describing boron alloys for use in tool steels, castings, machine parts, dies, and welding rods.

128. Control Valves. Kieley and Mueller Inc., North Bergen, N. J.—Catalog 47. This is a bound collection of bulletins which cover various types of equipment made by this company. These bulletins and the subjects they cover are as follows: Bulletin No. 1000, diaphragm valves and accessories; Bulletin No. 2,000, liquid level controllers; Bulletin No. 3,000, strainers; Bulletin No. 4,000, pressure reducing and regulating valves, and pump governors; Bulletin No. 5,000, steam plant specialties. The different types of equipment are well illustrated with photographs and cut-away views. Included are material specifications for different types of equipment, selection and ordering information, tables of capacities, dimensions and weights, etc.

129. Instruments. Surface Combustion Corporation, Toledo, Ohio—4-page booklet No. SC-137 featuring this company's dew point recorder. Includes schematic diagram of the dew point recorder circuit.

130. Steel. Joseph T. Ryerson & Son, Inc., Chicago, Ill.—4-page leaflet describes the abrasion resisting steel plates plates and sheets available from this company. Includes information on typical applications and performance.

131. Water Treatment. Calgon Inc., Pittsburgh, Pa.—Six-page folder illustrating and describing Micromet feeders for use in preventing corrosion, and limescale for small and medium sized users of water such as small manufacturing plants, dairies, small hotels, etc.

132. Industrial Photography. Eastman Kodak Co., Rochester, N. Y.—12-page booklet showing examples of actual industrial and engineering problems solved by ultra-speed photography.

133. Soy Bean Chemicals. The Glidden Co., Cleveland, Ohio—Brochure entitled "Industrial Soya Protein" contains information on soya products.

134. Packaging Tape. Industrial Tape, Inc., New Brunswick, N. J.—4-page leaflet featuring Permacel cold packaging tape for use in packaging products that must be kept in cold storage.

135. Couplings. John Waldron Corp., New Brunswick, N. J.—4-page pocket-sized folder featuring the new series "A" Waldron gear type coupling. Details of construction are shown.

136. Valves. Schutte & Koerting Co., Philadelphia, Pa.—20-page bulletin No. 8-V illustrates and describes boiler stop valves, check valves, stop and check valves and valves for medium and high-pressure service. Contains complete information on construction parts and materials used in these valves in addition to dimensions and performance data.

137. Water Treating. Alhydro Inc., Baltimore, Md.—4-page booklet describing the floc producing equipment made by this company. This equipment utilizes an electronic method of forming floc in water-treatment plants.

138. Industrial Ovens. Gehnrich & Gehnrich Inc., New York, N. Y.—32-page manual describing industrial processing ovens for use in a variety of industries.

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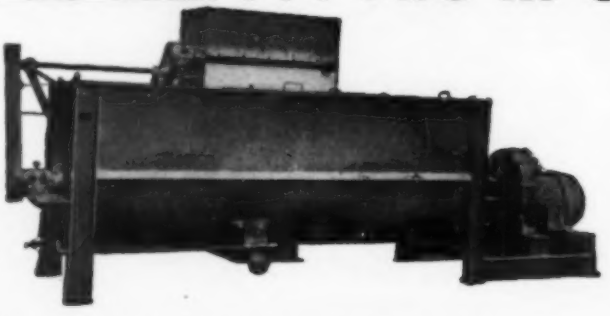

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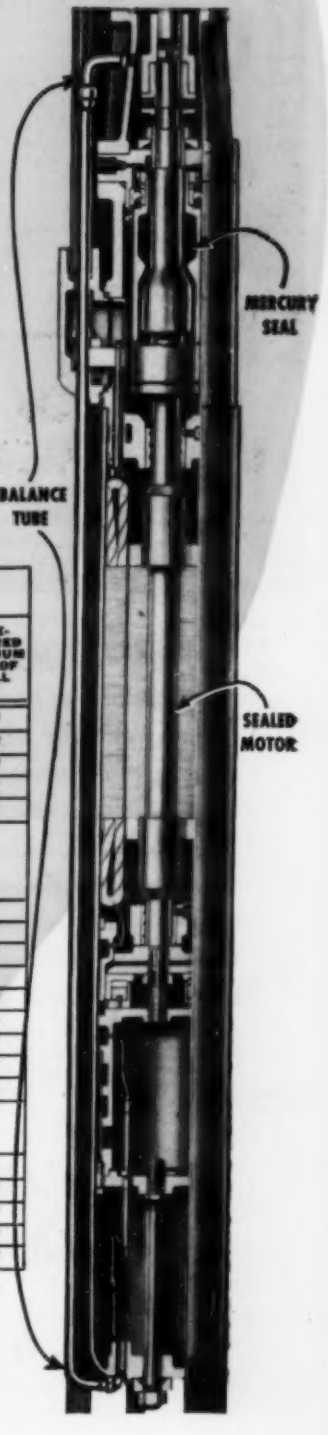

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TYPE B
Relatively low capacity, high head operation

TYPE K
General Deepwell applications

TYPE R
Relatively high capacity, low head operation

PUMP NO.	OUTSIDE DIA. OF BOWLS	RANGE OF CAPACITY IN GAL. PER MIN.	MINIMUM DIA. OF WELL WHICH PUMP WILL ENTER	PREFERRED MINIMUM DIA. OF WELL
TYPE B				
0B	7¼"	25- 350	8"	10"
1B	9¼"	100- 450	10"	12"
2B	11¼"	200- 750	12"	14"
3B	13¼"	250-1200	14"	16"
5B	15¼"	300-1600	16"	18"
TYPE K				
0K	7¼"	125- 500	8"	10"
1K	9¼"	150- 750	10"	12"
1½K	9¾"	200- 900	11"	12"
2K	11¼"	250-1350	12"	14"
3K	13¼"	400-2200	14"	16"
5K	15¼"	500-3300	16"	18"
6K	17⅜"	600-4000	18"	20"
7K	19⅜"	750-5200	20"	22"
8K	22¾"	1000-7000	24"	26"
TYPE R				
0R	7¼"	300- 500	8"	10"
1R	9¼"	500-1000	10"	12"
2R	11⅜"	1100-2000	12"	14"
3R	13⅜"	1500-3200	14"	16"
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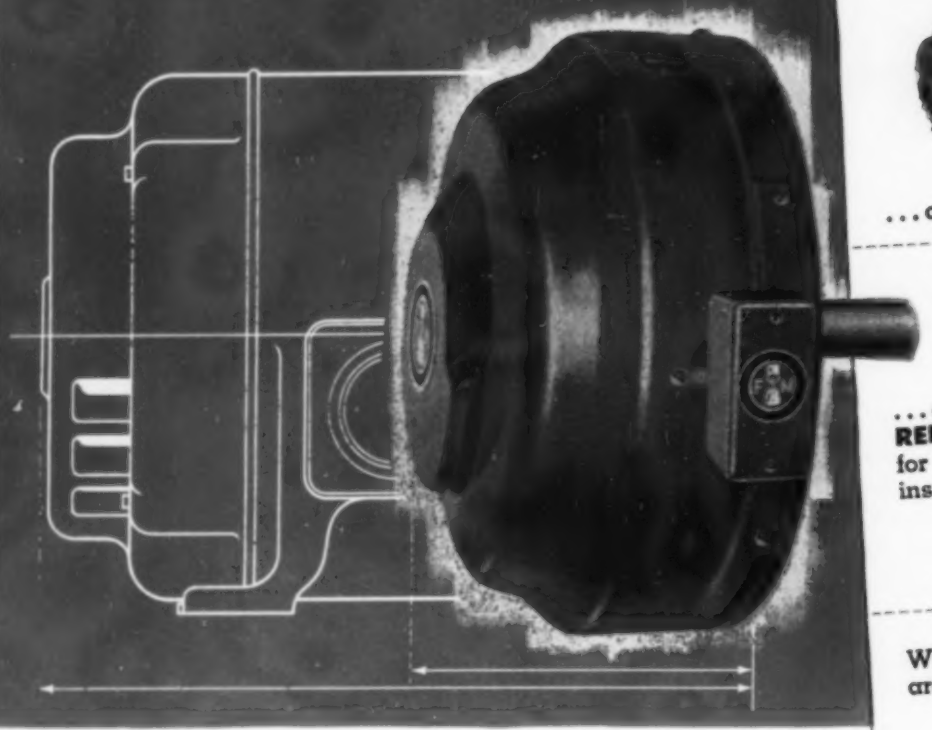
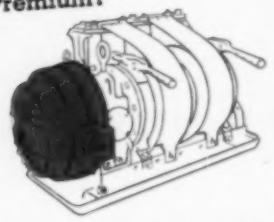


Where Floor Space is at a Premium?



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Where Headroom Counts?

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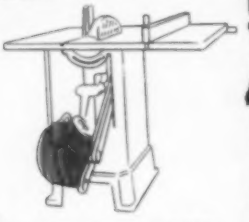

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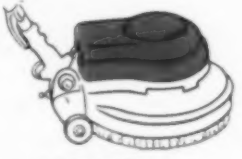

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CHEMICAL ECONOMICS

Richard F. Warren, ASSISTANT EDITOR

Strikes Hold Chemical Consumption Below Record First Quarter Levels

PRELIMINARY estimates indicate that chemical consumption during the second quarter of this year may fall below the record high established in the first quarter. This is primarily due to labor trouble, a seasonal slack in some industries, and the arrival of hot weather and vacation time.

Index at New High

Chemical Engineering's index of industrial chemical consumption reached a new high in March, at 242.55. It was far above the 1947 annual average of 221.85. The average for the first quarter was 231.28. This is the highest quarter on record. Many factors combined to make the consumption high. In fact, many things including a very hard winter held back consumption. This should point up the fact that it is possible for these new records to fall in the near future, provided labor troubles do not hamstring production.

Strikes like the one in the Columbia Division of Pittsburgh Plate Glass have created a tightening of the alkali supply. Prior to the strike, supply and demand were moving toward a balance.

Labor trouble in the Pacific Northwest's plywood industry has combined with additional supplies of methanol and increased capacity to ease the supply of formaldehyde in May. Phenol demand is strong and molding compound production is high.

Fertilizer Production

Fertilizer outlook is good. Production is growing steadily. The relationship between prices received by farmers and fertilizer prices determines the rate and extent to which fertilizer application is profitable. Farmers are paying about 12 percent more for fertilizer than they did last year, but crop prices have advanced about 20 percent in the same period. Supplies of fertilizers are expected to continue to grow. Industry spokesmen expect the total to reach 20,000,000 tons by 1950.

Cotton consumption gives an indication of the rate of chemical consumption in a large part of the textile industry. Therefore figures recently released give a good indication of chemical requirements in this industry. Trade sources estimate that 9,000,000-9,300,000 bales of cotton will be consumed this crop year as compared with 10,035,000 bales consumed last year. Chemical consumption in the wool industry is about 14 percent below the 1947 levels.

Fully recovered from the effects of the coal strike, the iron and steel industries are consuming larger quantities of chemicals. A continued growth is indicated for the rest of the year as new facilities are completed.

Chemical Engineering Index

Industrial Consumption of Chemicals

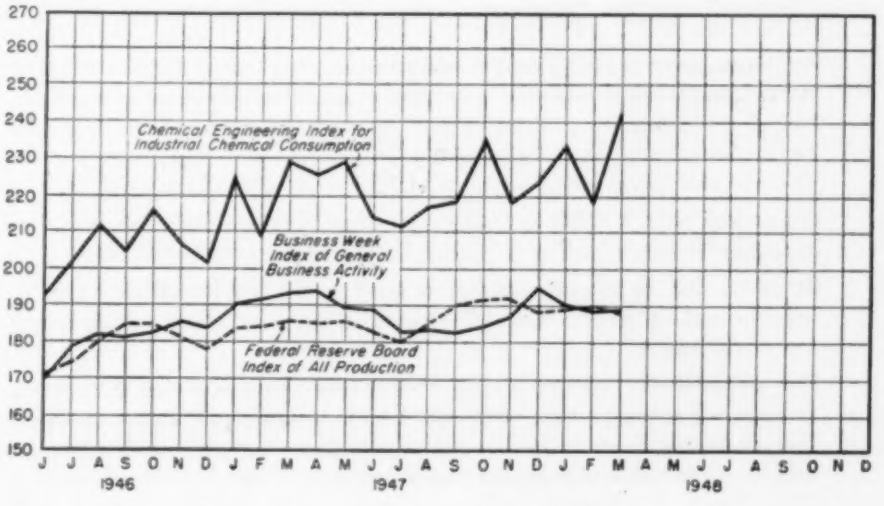
1935 = 100

	Feb. (Revised)	Mar.
Fertilizers	53.50	61.95
Pulp and Paper	21.60	24.90
Petroleum refining	20.42	21.75
Glass	17.05	19.65
Paint and varnish	21.85	25.40
Iron and steel	12.74	13.98
Rayon	23.82	26.20
Textiles	10.80	12.00
Coal products	10.05	10.28
Leather	5.01	4.73
Explosives	7.15	7.19
Rubber	5.09	5.52
Plastics	7.76	8.98
INDEX	216.84	242.55

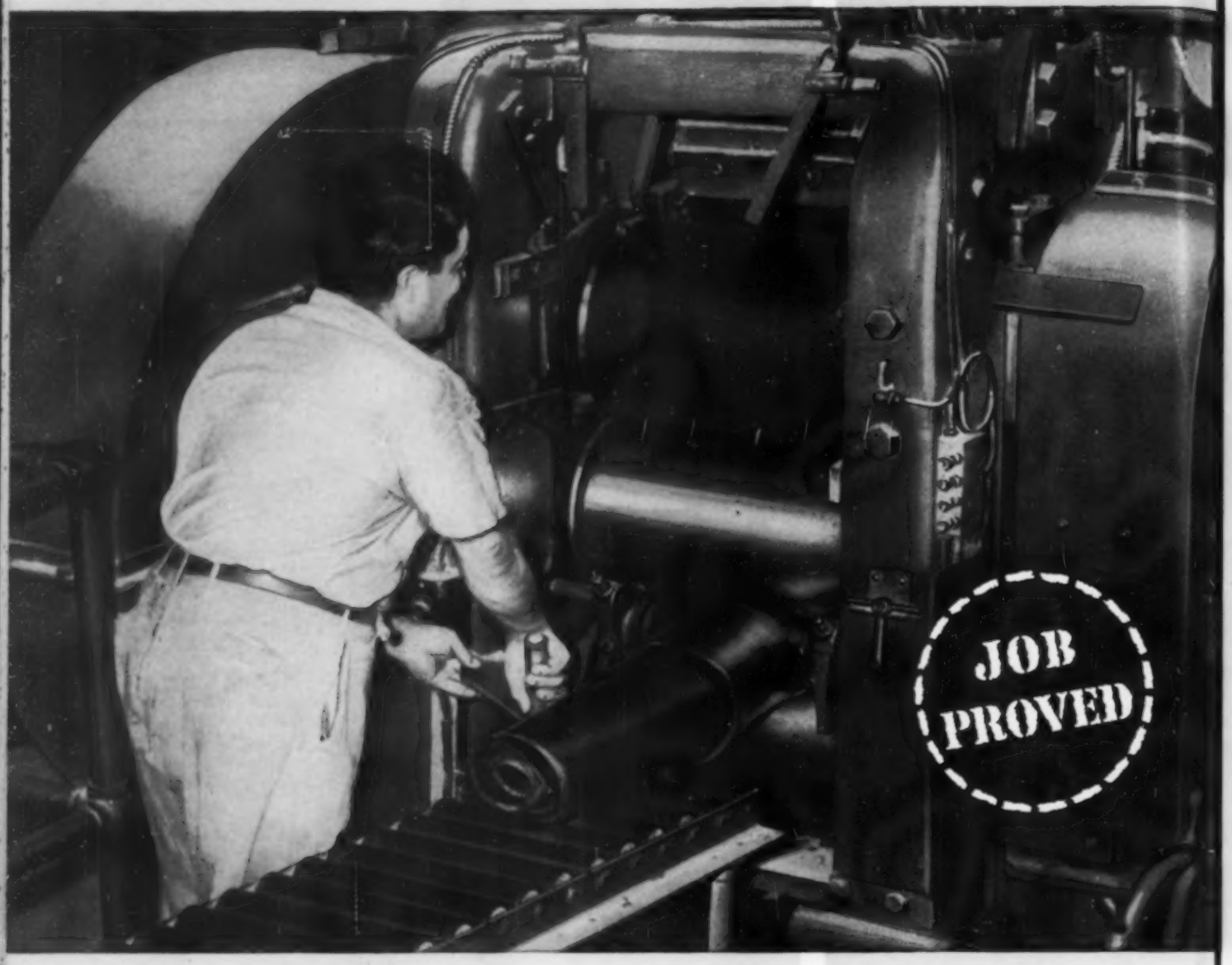
Pulp and Paper

Pulp and paper industry, a big consumer of chemicals, is well above the levels reached in the corresponding period of 1947. Paper and board production reached a new high in March. Pulp production also established a record of 1,086,391 tons or 15,336 tons above the previous high it hit last October.

Inorganic chemicals joined the parade of chemical consuming industries setting new records in March. New records were set up by synthetic ammonia plants. Ammonium nitrate, chlorine, caustic soda, soda ash, hydrogen, phosphoric acid, and sodium silicate also broke existing monthly records. The increase in production of these chemicals was largely due to increased operating activity at existing units. Diamond's new unit at Houston has begun operations and the chlorine and caustic records will probably fall in the near future as this and other new units begin to reach capacity output.



Saving $2,000 a Year



SUNDEX RUBBER PROCESSING AID...

Gives Greater Strength and Wear-Resistance to GR-S Stocks for Heavy Footwear

A manufacturer of heavy rubber footwear recently tested samples of GR-S rubber made with Sundex 53, and samples made with three other products, including his regular processing aid. In every case the rubber that had been plasticized and softened with the Sun product had better tensile strength and gave better results in elongation and abrasion tests.

A saving of $2,000 a year was effected in this plant as a result of changing to Sundex 53 — a higher quality product that costs less.

Sundex 53 is clean, uniform and easy to handle. It can be used in making various colored rubbers (other than white) without causing discoloration.

For practically every type of rubber there is a Sun processing aid that will speed up manufacture and improve quality. They do not cause surface bloom even in exacting products like chemically-blown sponge rubber, white sidewall tires and pastel-colored articles. For full information about Sun's "Job Proved" rubber processing aids, write Department CE-6.

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INDUSTRIAL PRODUCTS

FROM MINES and refineries at Carlsbad, N. M., similar to this United States Potash Co. unit comes 85 percent of the country's domestic potash.

Potash

POTASH industry in the United States is growing. Output in terms of K_2O, industry's yard stick of production, passed the 1,000,000-ton mark last year. Production this year will be larger. The table shows the past production and consumption as well as the estimated future pattern. Secretary Krug made these estimates in connection with ECA.

While official figures are not available, industry experts estimate that the Potash Co. of America is the biggest producer of high grade potassium chloride. From the standpoint of total K_2O, the Potash Co. of America is the largest producer with U. S. Potash a close second. Production at International's mine and refinery runs about 5,400 tons of crude per day with a total product of 1,450 tons. This year expansion is under way on new refinery facilities at Carlsbad. The company is spending $1,000,000 on this expansion. The Potash Co. of America has a $4,000,000 expansion program under way with general plant expansion, underground equipment, and refinery facilities included in the over-all program. Continental Potash Co. is building a pilot plant about 15 miles northeast of Carlsbad. This unit will try solution mining methods and the plant is scheduled to handle about 50 tons of potash per day.

United States production of potash grew out of the need for a domestic source for American agriculture and industry. Prior to this time the German Potash Trust controlled the market in the United States.

New Mexico, California and Utah supply practically all of the domestic product, most of this coming from deep Permian sedimentary deposits of sylvite and langbeinite of the Carlsbad region. Michigan supplies some of the product from well brine and Maryland's production comes from the by-product of cement operations.

According to data gathered by the American Potash Institute, potash deliveries in North America topped the million ton mark in 1947. Five leading producers and two importers delivered over 1,071,000 tons of K_2O, an increase of 148,143 tons of K_2O over 1946. European potash salts of French, German and Russian origin appeared in the United States market again for the first time since World War II. Imports of European potash into Canada are not included in the figures given above. Deliveries for chemical purposes in 1947 were 127,609 tons of muriate of potash containing the equivalent of 80,133 tons of K_2O and 5,078 tons of sulphate of potash containing 2,573 tons K_2O. The total chemical deliveries of 82,707 tons of K_2O were 9 percent greater than in 1946.

Three major producers in New Mexico produced a total of 84 percent of the over-all domestic supply in 1946. Four other states, California, Maryland, Michigan, and Utah, produced commercial quantities of the potash salts this year. California, while a much smaller producer than New Mexico, supplied 221,825 tons of potash in 1947. Dow Chemical Co. began operations in 1946 in Michigan. In New Mexico, all three companies produced potassium chloride and one, International Minerals & Chemical Corp., also produced langbeinite which is potassium-magnesium sulphate. Most of the sylvite was processed to 60 percent or higher grade muriate. The Potash Co. of America also produces potassium sulphate at Carlsbad.

A Senate investigation of the industry started in 1936 and continued intermittently for four years, the companies were given a clean bill of health in 1940. However, government edicts had stopped exploration for new potash reserves. In 1945 the Interior Department issued new regulations regarding potash leases. Existing companies with a maximum of six leases were prohibited from having permits to search for potash on other land. After two years of conferences the regulations were amended in March 1947. Now any company can have prospecting rights on 40,000 acres, or 25,000 in addition to the land that it has leased, and the Secretary of the Interior can commandeer only 10 percent of the output.

Producers

Company	Plant
Potash Co. of America	Carlsbad, N. M.
United States Potash Co.	Carlsbad, N. M.
American Potash and Chemical Co.	Trona, Calif.
International Minerals and Chemical Corp.	Carlsbad, N. M.
Bonneville Ltd.	Wendover, Utah
Dow Chemical Co.	Midland, Mich.
North American Cement Corp.	Security, Md.
Max Krotki	Marysvale, Utah
Continental Potash Co	Carlsbad, N. M.

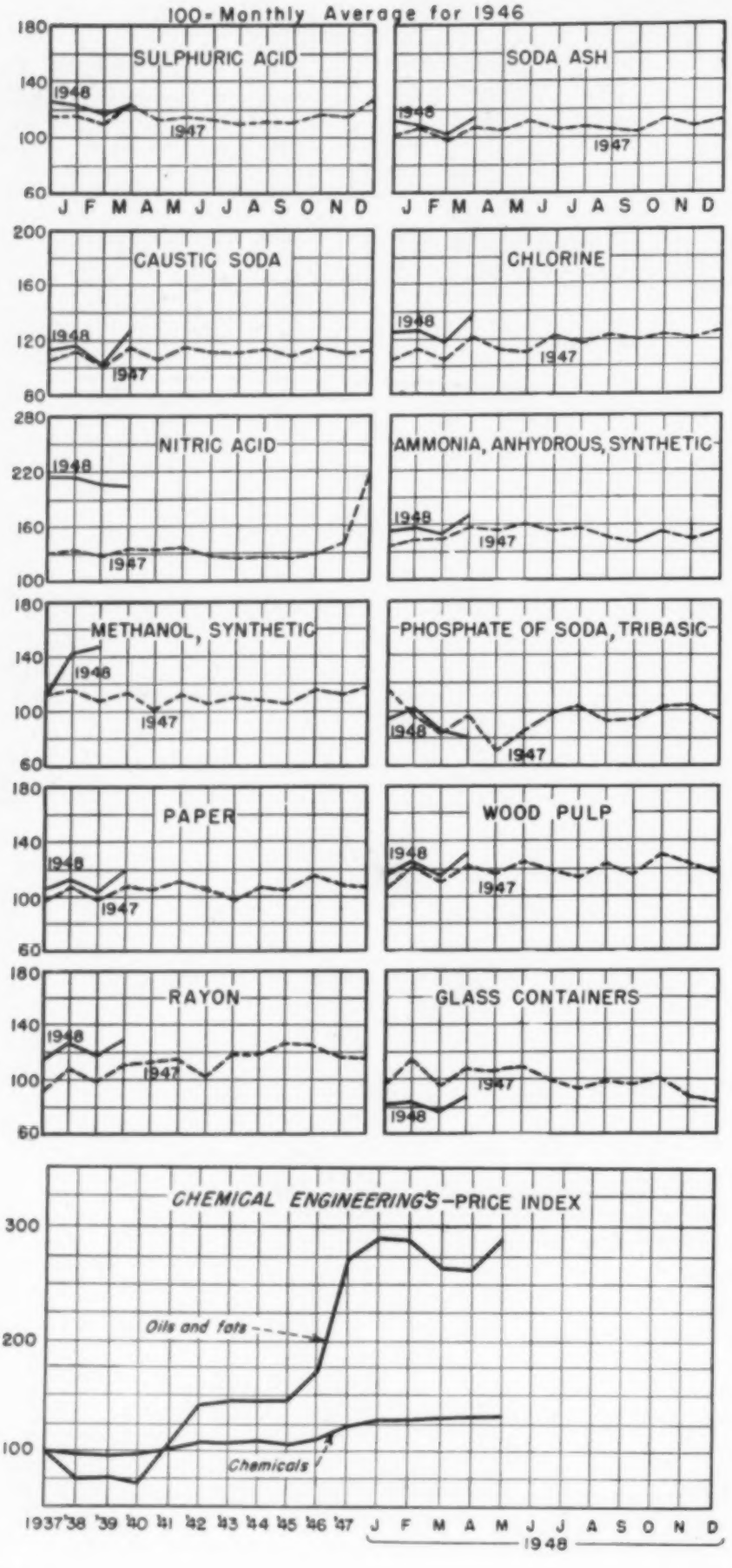
Record of Past and Estimate of Future

In tons of K_2O

Year	Production	Exports	Imports	Consumption
1919	45,700	500*	39,619	85,000
1920	41,400	700*	224,792	266,000
1923	19,300	2,000*	209,950	227,000
1925	25,800	1,000*	258,217	283,000
1927	49,500	900*	244,155	293,000
1929	57,500	8,000*	324,638	374,000
1931	63,800	16,000*	214,785	262,000
1933	139,100	18,000*	171,854	293,000
1935	224,700	50,000*	241,000	420,000
1937	266,900	62,000	351,445	556,000
1939	366,300	83,800	100,129	382,000
1941	531,300	56,873	15,818	490,000
1943	732,200	70,007	17,109	679,000
1945	870,400	67,583	6,023	809,000
1947	1,000,000	60,000	20,000	960,000
1948*	1,025,000	50,000	25,000	1,000,000
1949*	1,050,000	50,000	50,000	1,050,000
1950-52*	1,100,000	50,000	100,000	1,150,000

* Estimated. Source: Minerals Yearbooks, Bureau of Mines.

PRODUCTION, CONSUMPTION AND PRICE TRENDS



RAYON imports in the first two months of the year were higher than any annual total since 1931. First quarter production was 16 percent above the same quarter last year, and 3 percent higher than the October-December level. This was the seventh consecutive quarter that the industry has established a new quarterly output record. If this rate is maintained, an annual output of over one billion pounds is expected.

Commercial production of a new synthetic fiber marks a rebirth of the Taftsville, Conn., plant designed to produce Aralac. The new vegetable protein fiber is called Vicara. Virginia Carolina Chemical Corp., the producer, estimates the present capacity of the plant at 10 million pounds per year. However, it will only produce about 2.5 million pounds annually until the demand is determined.

Ammonia production, already behind demand, suffered a setback in May as labor trouble hit Commercial Solvents and Solvay's South Point plant. Lion is building additional capacity to satisfy the need for ammonia.

Sulphuric acid production is below the output for the same period in 1947. Nitric acid output is running about 60 percent ahead of last year's rate. Phosphoric is up 15,000 tons per month above operating levels maintained last year.

Soda ash is at approximately the same operating level that was reached in the first months of 1947. Additional production of natural ash from the Westvaco mining operations was reflected in a gradual growth in this part of the industry.

Price Trends

Price trend in May was mixed. June chemicals index was down slightly. Fats and oils index rose above January levels to 308.81. Du Pont raised ammonia to $70 per ton in large lots. Solvay will raise its alkali prices on July 1. Turpentine, shellac, tallow, and some essential oil prices dropped during the month.

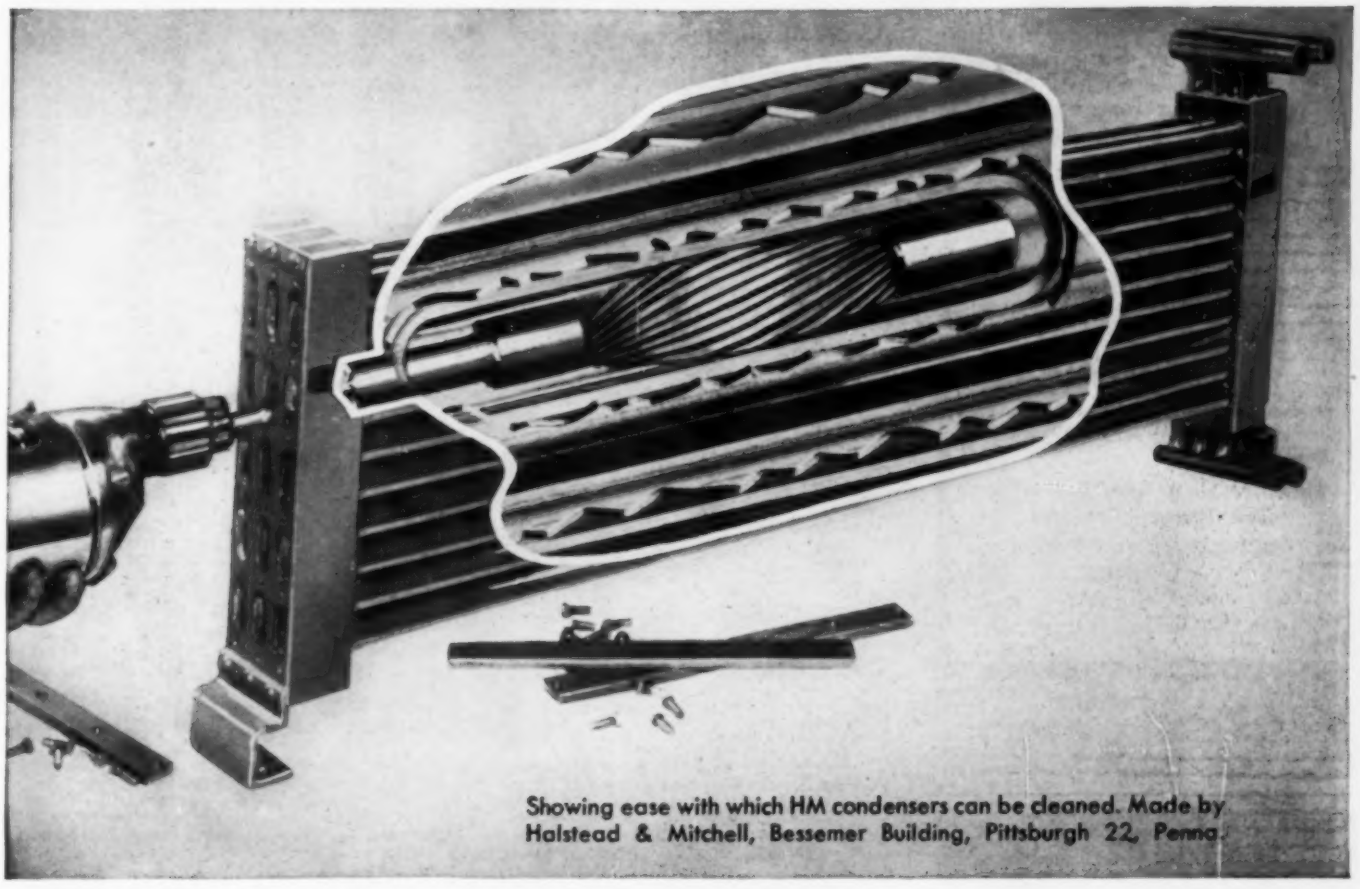
Chemical Engineering

WEIGHTED INDEXES OF PRICES

Base = 100 for 1937

	Chemicals	Oils & Fats
As of June 1..	131.01	308.81
Last Month ..	131.11	289.53
June 1947	124.02	237.60
June 1946	109.13	145.80

REVERE COPPER TUBE PROTECTS CONDENSER QUALITY AND SERVICE



Showing ease with which HM condensers can be cleaned. Made by Halstead & Mitchell, Bessemer Building, Pittsburgh 22, Penna.

This illustration shows one of the features of HM Condensers—cleanability. In the words of the manufacturer:

"These new HM units combine two qualities never before obtainable in tube-within-a-tube, water-cooled condensers—they're cleanable, and they achieve true counterflow heat-exchange relationship between the coolant and the refrigerant, enabling water requirements to be reduced without sacrificing condenser unit capacity."

AN IMPORTANT FACTOR not seen is the use of Revere seamless copper tube for both the inner and outer tubes of the condenser, and also rectangular brass rod for the header bar. This tube as well as the bar, must be practically perfect, in order to avoid the possibility of leakage during the expected normal life of the condenser, a life which is greatly extended due to the fact that the water tubes are accessible at both ends for insertion of the spiral cleaning tool. The manufacturer, Halstead & Mitchell, recently gave Revere a pleasing but not unusual compliment, saying that no Revere tubes had ever proved defective.

Revere offers condenser tubes not only in copper, but in Admiralty Metal, Muntz Metal, Revalon (Aluminum Brass), Herculoy, Brass, and three types of Cupro-Nickel. See Revere for condenser tubes.

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United States Production of Certain Chemicals

March 1948, March 1947 and Three-Month Totals for 1948 and 1947

Chemicals (Tons unless otherwise noted)	March 1948	March 1947	Total, Three Months 1948	Total, Three Months 1947
Ammonia, synthetic, anhydrous[1]	100,142	95,859	286,097	266,643
Ammonium nitrate	95,407	90,333	279,443	264,150
Ammonium sulphate, synthetic, technical, (M lb.)	28,779	34,764	95,743	86,042
Calcium arsenate (M lb.)	3,379	1,221	7,815	4,529
Calcium carbide, commercial	61,489	52,466	174,586	158,552
Calcium phosphate:				
Monobasic (M lb.)	5,557	6,999	17,318	19,524
Dibasic (M lb.)	7,696	5,128	19,457	20,739
Carbon dioxide:				
Liquid and gas (M lb.)	20,511	15,709	54,169	47,331
Solid (M lb.)	50,079	46,740	132,850	125,430
Chlorine	132,668	117,039	372,130	328,844
Chrome green, (C. P.), (M lb.)	1,240	1,299	3,175	4,229
Chrome yellow and orange, (C. P.), (M lb.)	4,886	3,483	12,769	10,377
Hyrdochloric acid	36,579	36,993	109,608	106,103
Hydrogen, (million cu. ft.)	2,268	1,683	6,589	4,898
Lead arsenate, acid and basic, (M lb.)	3,654	4,481	10,580	13,095
Molybdate chrome orange, (C. P.), (M lb.)	474	422	1,443	1,259
Nitric acid	101,041	64,647	305,421	190,978
Oxygen, (million cu. ft.)	1,361	1,218	3,890	3,329
Phosphoric acid, 50 percent	106,246	89,050	292,178	242,571
Soda ash[2]				
Ammonia soda process:				
Total wet and dry[2]	404,525	383,753	1,148,443	1,114,976
Finished light[3]	202,795	184,018	303,595	546,781
Finished dense	134,765	142,184	352,374	401,184
Natural[4]	23,896	23,071	69,688	60,387
Sodium bicarbonate	14,698	16,571	32,059	47,385
Sodium bichromate and chromate	7,971	7,129	22,741	20,062
Sodium hydroxide:				
Electrolytic process:				
Liquid[5]	130,292	115,198	362,022	320,626
Solid	24,297	18,240	70,729	52,895
Lime soda process:				
Liquid[5]	68,366	64,202	193,117	188,929
Solid	21,982	20,057	63,199	59,868
Sodium phosphate:				
Monobasic	1,194	1,242	2,091	3,614
Dibasic	8,546	6,956	21,172	19,228
Tribasic	6,345	7,672	21,229	22,083
Meta	3,461	2,741	8,582	7,053
Tetra	6,105	4,252	16,157	12,254
Sodium silicate, anhydrous	54,702	42,120	136,321	117,995
Sodium sulphate:				
Anhydrous	14,220	11,967	39,491	34,611
Glauber's salt[6]	15,826	19,152	49,906	52,923
Salt cake, crude, commercial[6]	53,862	50,907	154,289	146,619
Sulphuric acid[6, 7]				
Chamber	284,954	306,600	844,735	880,443
Contact, new	614,727	574,933	1,779,435	1,633,878
Zinc yellow, (zinc chromate) (C. P.)	345	257	1,045	774

Data for this tabulation have been taken from "Facts for Industry" series issued by Bureau of the Census. Production figures represent primary production and do not include purchased or transferred materials. Quantities produced by government-owned arsenals, ordnance works, and certain plants operated for the government by private industry are not included. Chemicals manufactured by TVA, however, are included. All tons are 2,000 lb. Where no figures are given data are either confidential or not yet available. [1]Includes a small amount of aqua ammonia. [2]Total wet and dry production, including quantities diverted for manufacture of caustic soda and sodium bicarbonate, and quantities processed to finished light and finished dense. [3]Not including quantities converted to finished dense. [4]Data collected in cooperation with the Bureau of Mines. [5]Figures represent total production of liquid materials, including quantities evaporated to solid caustic and reported as such. [6]Includes oleum grades, excludes spent acid. [7]Data for sulphuric acid manufactured as a byproduct of smelting operations are included.

United States Production of Synthetic Organic Chemicals

February 1948, February 1947, and Two-Month Totals for 1948 and 1947

	February 1948	February 1947	Two Months Totals 1948	Two Months Totals 1947
Acetanilid	582,961	559,542	1,027,295	1,287,232
Acetic acid:				
Synthetic[1]	30,544,594	28,685,625	62,437,547	61,683,056
Recovered	126,085,765	107,722,325	268,842,029	229,134,756
Natural[2]	2,079,052	1,984,112	4,375,340	4,138,562
Acetic anhydride[3]	58,193,746	45,662,447	120,883,072	94,819,727
Acetone	35,342,525	27,876,019	72,287,121	59,597,829
Acetylsalicylic acid	984,691	1,023,817	1 964,102	1,949,272

(Continued on page 318)

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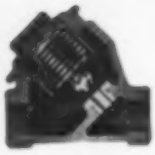

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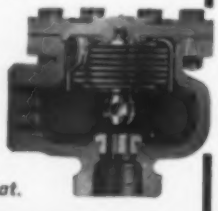

Bulletin 1047
or see Chem. Eng. Cat.

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U. S. Production of Synthetic Organic Chemicals (Cont. from page 316)

	February 1948	February 1947	Two Month Totals 1948	Two Month Totals 1947
Aniline	7,443,059	8,458,738	16,931,676	17,321,248
5-Ethyl-5-phenylbarbituric acid and salts (phenobarbital)	45,638	24,754	107,410	63,926
Benzene:				
Motor grade:				
Tar distillers[4]	.....	712,333	.....	1,398,610
Coke-oven operators[5]	856,788	1,490,390	1,067,505	3,663,346
All other grades:				
Tar distillers[4]	1,073,647	2,268,150	2,252,645	4,409,050
Coke-oven operators[5]	12,089,988	11,211,211	24,912,787	23,843,194
Butyl alcohol, primary, normal	9,900,117	8,729,231	21,046,397	22,706,433
Carbon bisulphide	30,733,296	26,613,022	60,892,429	55,800,549
Carbon tetrachloride	17,740,263	17,664,871	36,378,538	33,430,323
Chlorobenzene, mono	26,210,077	23,224,220	55,370,823	47,576,554
Creosote oil:				
Tar distillers[4]	8,719,280	11,691,769	18,229,737	22,388,507
Coke-oven operators[5]	3,115,502	2,888,472	6,447,534	6,229,579
Cresols, meta-para[7]	710,969	422,861	1,292,862	809,272
Cresols, ortho-meta-para[7]	825,658	724,387	1,237,086	1,288,909
Cresylic acid, refined[6, 10]	1,617,458	2,141,772	3,586,211	4,235,783
Dibutyl phthalate	827,597	1,949,696	3,332,724	3,994,371
Dichlorodiphenyltrichloroethane (DDT)	2,234,776	3,933,467	4,556,322	8,025,709
Ethyl acetate, 85 percent	5,711,863	7,083,650	10,972,655	17,268,859
Ethylene glycol	23,061,563	14,670,291	46,069,099	32,224,919
Ethyl ether	3,181,100	3,517,781	5,605,277	7,536,980
Formaldehyde, 37 percent	51,927,967	41,665,947	104,424,339	88,006,571
Hexachlorocyclohexane	1,353,282	206,578	2,669,350	354,411
Methanol, synthetic	60,422,172	44,361,941	118,894,529	91,804,084
Methanol, natural[8]	1,312,635	1,221,640	2,768,017	2,689,120
Naphthalene:				
Tar distillers, less than 79°C	17,960,905	17,078,801	32,102,683	35,777,880
Tar distillers, 79°C and over	8,290,657	7,884,167	18,300,277	16,574,895
Coke-oven operators, less than 79°C	8,123,490	6,446,832	16,655,424	13,712,983
Penicillin and salts	7,057,264	2,635,453	12,654,519	5,765,807
Phenol	24,721,206	15,731,032	49,694,332	34,301,814
Phthalic anhydride	12,047,503	10,846,500	24,480,620	22,534,075
Styrene, government and private plants	30,886,539	31,118,414	56,871,949	69,298,035
Toluene:				
Coke-oven operators	2,304,878	2,063,739	4,732,778	4,073,801
All other[9]	5,561,714	3,143,378	8,906,614	6,121,115
Xylene, crude	4,863,366	3,852,217	8,222,449	7,589,937

All data in pounds except benzene (gal.) creosote oil (gal.), toluene (gal.) xylene (gal.) and penicillin (million Oxford units). Statistics collected and compiled by U. S. Tariff Commission except where noted. Absence of data on production indicates either that returns were unavailable or confidential. [1]Excludes the statistics on recovered acid. [2]Acid produced by direct process from wood and from calcium acetate. [3]All acetic anhydride including that from acetic by vapor-phase process. [4]Product of distillers who use purchased coal tar only or from oil-gas or water-gas produced or purchased by tar distillers. [5]Statistics are given in terms of bulk medicinals only. [6]Statistics collected by Bureau of Mines. [7]Total production including data reported both by coke-oven operators and by distillers of purchased coal tar. [8]Reported to U. S. Bureau of the Census. [9]Includes toluene produced from petroleum by any process. [10]Includes refined cresylic acid from petroleum.

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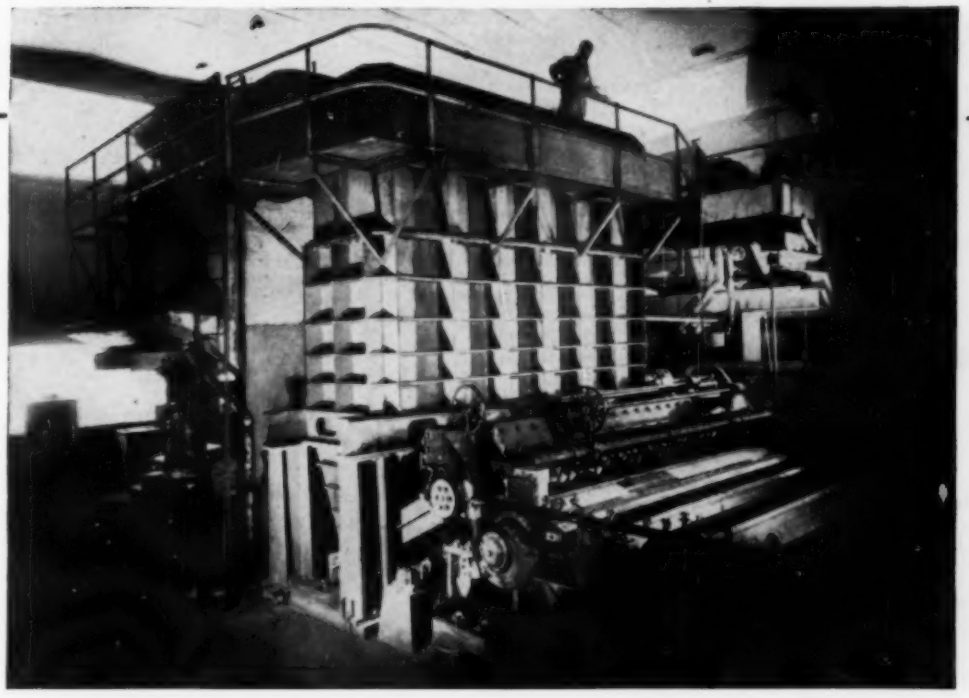

This paper machine headbox, built of Lukens Stainless-Clad Steel, replaced another type of structure. It regulates the flow of pulp to a paper-making machine, according to the type of paper being made.

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NEW CONSTRUCTION

	Current Projects		Cumulative 1948	
	Proposed Work	Contracts	Proposed Work	Contracts
New England	.....	.....	.....	$1,431,000
Middle Atlantic	$4,390,000	$32,220,000	$6,666,000	14,462,000
South	20,000,000	2,100,000	77,285,000	66,021,000
Middle West	300,000	7,443,000	12,950,000	24,967,000
West of Mississippi	15,533,000	3,500,000	129,268,000	28,472,000
Far West	.....	2,525,000	12,150,000	25,279,000
Canada	.....	350,000	31,990,000	21,145,000
Total	$40,223,000	$48,138,000	$270,309,000	$181,777,000

Proposed Work

Mo., St. Louis—Hadley Bros.-Uhl Co., 3952 Pine St., manufacturer of rubber cement, etc., plans to construct a 1 story, 107x282 ft. factory. John A. Grunik, 6635 Delmar Blvd., Archt.

N. J., Woodridge—Shell Oil Co., 50 West 50th St., New York, N. Y., has acquired a 400 acre site in Woodridge and 200 acres in Carteret and plans to construct an oil refinery and laboratory.

N. Y., New York—S & S Soap Co., 324 Barrett St., New York City, plans to construct a soap factory on East 125th St. east of Willow Ave. Estimated cost $320,000.

O., Akron—Harwick Chemical Co., Akron Savings & Loan Bldg., plans to construct a 2 story chemical factory for the manufacture of plastics to include warehouse and laboratory for research. Estimated cost $300,000.

Pa., Harmarville—Gulf Research & Development Co., Gulf Bldg., Pittsburgh, plans to construct a chemistry building here. Estimated cost $2,500,000.

Pa., Harrisburg—Pittsburgh Plate Glass Co., 611 South 17th St., plans to construct a 1 story, 100x175 ft. addition to its factory. Estimated cost $70,000.

Pa., Reading—Consumers Gas Co., 441 Penn St., plans to construct a catalytic gas plant. United Engineers & Constructors, Inc., 1401 Arch St., Philadelphia, Engr. Estimated cost $1,000,000.

S. C., Camden—E. I. du Pont de Nemours & Co., Inc., du Pont Bldg., Wilmington, Del., plans to construct a plastics plant here. Estimated cost $20,000,000.

Tex., Baytown—Humble Oil & Refining Co., Baytown, plans to construct a pipe still. Estimated cost $1,500,000.

Tex., Brazoria—Phillips Petroleum Co., Bartlesville, Okla., plans to construct a gasoline extraction plant here. Estimated cost $5,000,000.

Tex., Ft. Worth—Cook Paint & Varnish Co., 5th and Throckmorton Sts., plans to construct a 1 story warehouse. Estimated cost $175,000.

Tex., Pasadena—Phillips Petroleum Co., Bartlesville, Okla., plans to construct a chemical plant for the production of ammonium sulphite fertilizer. Estimated cost $8,000,000.

Tex., Port Neches—Absorption Plant, Inc., c/o McCarthy Oil, Gas & Chemical Corp., Shell Bldg., Houston, plans to construct a gasoline and oil products storage plant. Estimated cost $90,000.

Tex., Sweeney—Alamo Refining Co., (affiliate of Phillips Petroleum Co., Bartlesville, Okla.), plans refinery expansion here. Estimated cost $700,000.

Contracts Awarded

Ark., El Dorado—Lion Oil Co., T. H. Barton, Bd. Chn., has awarded the contract for the design and construction of an anhydrous ammonia plant addition to Chemical Construction Corp., 350 5th Ave., New York, N. Y. Estimated cost $3,500,000.

Calif., Redwood City—Hodges Research Laboratory c/o Robert Dalton, Eng., 1723 Webster St., Oakland, has awarded the contract for a steel laboratory building to Remmett Construction Co., Box 878, Palo Alto. Estimated cost $75,000.

Del., Wilmington—E. I. du Pont de Nemours & Co., Inc., du Pont Bldg., will construct 10 laboratory and semi-work buildings for research with own forces. Estimated cost $30,000,000.

Ind., Hammond—Standard Oil Co., 910 South Michigan Ave., Chicago, Ill., has awarded the contract for a 3 story engineering and administration building to George A. Fuller Co., 111 West Washington St., Chicago, Ill. Estimated cost $5,000,000.

N. J., Trenton—Young Rubber Corp., Enterprise Ave., has awarded the contract for a 1 story, 76x239 ft. factory building to VanLeu & Van Horn, Inc., Flemington, N. J. Estimated cost $85,000.

N. Y., Binghamton—Afga Ansco Co., Binghamton, has awarded the contract for the construction of a new film plant to Vincent J. Smith, Inc., Capitol Theatre Bldg. Estimated cost $2,000,000.

O., Ashtabula—Electro Metallurgical Co., Ashtabula, has awarded the contract for three lime kilns, including screening and storage facilities, at Lake Road plant to Stevens Construction Co., Marion Bldg., Cleveland.

O., Toledo—Gulf Refining Co., 2935 Front St., has awarded the contract for a catalytic cracking plant and atmospheric vacuum topping still to E. B. Badger & Son, 75 Pitts St., Boston, Mass., at $1,396,000; waste oil separation plant and two quonset storage buildings to Bates & Rogers Construction Co., 56 Granada St., Toledo, at $180,000 and $9,000 respectively.

O., Toledo—Sun Oil Co., Philadelphia, Pa., has awarded the contract for a separator and oil recovery project to end pollution of Maumee Bay and Otter Creek at Woodville Rd, refinery to Catalytic Construction Co., Lewis Tower Bldg., Philadelphia. Estimated cost $600,000.

Pa., Kittanning—Linde Air Products Co., 30 East 42nd St., New York, N. Y., has awarded the contract for an addition to its factory to Clairton Commercial Co., St. Clair and State Sts., Clairton. Estimated cost $135,000.

Tenn., Chattanooga—Tennessee Products & Chemical Co., c/o Blaw-Knox Co., Farmers Bldg., Pittsburgh, Pa., contractor, will construct two plant buildings. Estimated cost $1,000,000.

Tex., Blue Ridge—Imperial Salt Co., Blue Ridge and 102 San Jacinto St., Houston, has awarded the contract for a salt evaporator plant, to A. I. Martin, 2300 Congress Ave., Houston. Estimated cost $350,000.

Tex., Fort Worth—Consolidated Chemical Industries, Inc., Denton Ave., Fort Worth, will remodel and construct an addition to its plant. Work will be done by owners. Estimated cost $100,000.

Va., Narrows—Celanese Corp. of America, 2 Park Ave., New York, N. Y., has awarded the contract for an addition to Bldg. No. 1, to George F. Hazelwood Co., foot of Howard St., Cumberland, Md. Estimated cost $600,000.

Wash., Longview—Pacific Paperboard Co., Longview, has awarded the contract for a newsprint plant to Collins, Swinerton & Walberg, 225 Bush St., San Francisco, Calif. Estimated cost $2,000,000.

W. Va., Fairmont—Owens-Illinois Glass Co., Fairmont, W. Va., has awarded the contract for a plant addition to Hughes-Foulkrod Co., Schaff Bldg., Philadelphia, Pa. Estimated cost $500,000.

Wis., Tomahawk—National Container Corp., Tomahawk, has awarded the contract for a 4 story, 96x96x80 ft. brick semi-chemical building to Tidewater Construction Co., 538 Front St., Norfolk, Va. Estimated cost $190,000.

B. C., Vancouver—United Distillers, Ltd., 8900 Shaughnessy St., has awarded the contract for an 8 story rack house to Associated Construction Co., Ltd., 445 Granville St. Estimated cost $350,000.